Nil
22-3-60

COMMONWEALTH BUREAU OF HELMINTHOLOGY
THE WHITE HOUSE,
103, ST. PETER'S STREET,
ST. ALBANS, HERTS.
9.3.60.

Vol. 42, No. 3, 1959

THE MALAYAN AGRICULTURAL JOURNAL

PRINCIPAL CONTENTS

OIL PALM SELECTION AND BREEDING: A PROGRESS REPORT. *By A. V. Haddon and Y. L. Tong.*

VISUAL SYMPTOMS OF MAJOR NUTRIENT DEFICIENCIES OF THE SINGAPORE SPANISH PINEAPPLE. *By K. Kanapathy.*

NOTES ON CURRENT INVESTIGATIONS AND EXTENSION WORK, JULY TO SEPTEMBER, 1959.

MINISTRY OF AGRICULTURE, FEDERATION OF MALAYA,
Kuala Lumpur.

PRICE $2

DEPARTMENT OF AGRICULTURE, FEDERATION OF MALAYA

ORGANIZATION (as on 30th September, 1959)

Director of Agriculture:—A. L. Barcroft, B.Sc. (Agric.) (*Acting*).
Deputy Director of Agriculture:—G. S. Keeping, B.Sc., Dip. Agr. Sci (Cantab.). (*Actng*).
Higher Executive Officer:—Yap Sin Hee (*Acting*).
Executive Officer:—K. Nagapen.
Financial Assistant:—V. Sundram.

RESEARCH BRANCH

Assistant Director (Research):—
F. N. G. Conaty, B.Sc. (Hons.), A.R.I.C.

(II) BOTANY

Senior Botanist:—
A. V. Haddon, B.Sc. (Hons.), Dip. Agr. Sci. (Cantab.) (*Acting*).

Plant Breeders:—
Van Thean Kee, B.Sc. (Hons.).
A. Santiago, B.Sc. (Malaya), M.Sc. (Alta.).
Tang Teng Lai, BA, Dip. Agr. Sci. (Cantab.).

Plant Physiologist:—
One vacancy.

Asst. Research Officer:—
Sulan bin Salleh.

(III) CHEMISTRY

Senior Chemist:—
G. W. Arnott, B.Sc. (Hons.), D.T.A.

Canning Officer:—
One vacancy.

Chemists:—
Two vacancies.

Assistant Chemist:—
One vacancy.

(IV) SOIL SCIENCE

Senior Soil Scientist:—
A. R. McWalter, B.Sc. (Hons.).

Soil Scientists:—
W. P. Panton, A.M.N., B.Sc. (Hons.), D.T.A.
K. Kanapathy, B.Sc. (Hons.) (Annamali), M.Sc., A.R.I.C.
K. T. Joseph, B.Sc. (Hons.), M.Sc.

Asst. Research Officer:—
S. Thamboo.

FIELD BRANCH

Assistant Director (Field):—
T. R. Dickinson, P.J.K., B.Sc. (Agric.), Dip. Agr. (Cantab.) D.T.A. (*Acting*).

Senior Agricultural Officer, Headquarters:—
Mohamad bin Jamil, B.Sc., D.I.C.T.A. (*Acting*).

Agricultural Economists:—
* T. B. Wilson, M.A. (Oxon.), Dip. Agric. Econ., D.T.A.
* S. Selvadurai, B.A. (Hons.).
* Mohd. Tamin bin Yeop, B.Sc. (Agric.).

Personal Assistant to Asst. Director (Field):—
Yoon Weng Kong.

KEDAH: *State Agricultural Officer*:-
J. L. B. Hitchcock, B.Sc. (Dunelm.)
Agricultural Officer:—
Vacant.
Asst. Agricultural Officers:—
Othman bin Mohd. Lela.
Muhammad bin Arshad

PERLIS: *State Agricultural Officer*:—
Mohd. Noor bin Wahab, B.Sc. (Agric.) (Dunelm.).

KELANTAN: *State Agricultural Officer*:—
L. A. Vivian, B.Sc., Dip. Agr. (Cantab.), D.T.A.
Agricultural Officer (Vacant).
Asst. Agricultural Officer:—
Hj. Mahmood bin Haji Yaacob, S.M.K.

TRENGGANU: *State Agricultural Officer*:—
Basir bin Ismail, P.J.K., B.Sc., (Agric.), (Dunelm.).
Asst. Agricultural Officer:—
Mohd. Noor bin Haji Abdul Hamid.

PENANG & PROVINCE WELLESLEY:
State Agricultural Officer:—
Ahmad bin Mohd. Amin, B.Sc. (Agric.).
Asst. Agricultural Officer:—
Mohd. Noordin bin Mohd. Kassim.

PERAK: *State Agricultural Officer*:—
Agricultural Officers:—
Perak North—
Wan Mohd. Don bin Mohamad, B. Agr.
Perak Central—
Zawawi bin Hamzah, B.Sc. (Agr.).
Perak South—Vacant.
Asst. Agricultural Officers:—
Mohd. Ibrahim bin Mohd. Ali.
Shahidin bin Mohd. Hassan

(Continued)

RESEARCH BRANCH (contd.)

(V) ENTOMOLOGY

Senior Entomologist:—(*Vacant*).

Entomologist:—
Ahmad bin Yunus, B.Sc. (Hons.), B. Agr.

Asst. Research Officer:—
Kamardin bin Bahar, A.M.N.

(VI) PLANT PATHOLOGY

Senior Plant Pathologist:—(*Vacant*).

Plant Pathologists:—
S. J. Navaratnam, B.Sc. (Hons.).
Ting Wen Poh, B.Sc. (Hons.).

AGRONOMY BRANCH

Senior Agronomist:—
C. Whitehead, B.Sc. (Hort.) D.T.A.,

Agronomists:—
R. J. R. Barrett, B.A. (Hons.), (Cantab.), Dip. Agric. (Cantab.).
G. I. M. Martin, B.Sc. (Agric.), Dip. Agric. (Cantab.), D.T.A., S.D.D.H.
Lee Sin Fook, B.Sc. (Agric.).
Aw-Yong Kong Keong, B.Sc., B. Agr. (Hons.).
Ajit Singh Sidhu, B.Sc. (Punjab) Ph.D., (Durham).
Four vacancies.

Agricultural Engineers:—
Two vacancies.

Livestock Officer:—*Vacant.*

Statistician:—
I. Watson, B.Sc., (Hons.). (*On Contract*).

Asst. Statistician:—
* Lee Yoke Heng.

Agricultural Development Officers:—
J. A. Cox, A.M.I.B.A.E.
A. I. Cumming, Ass. Mem. A.S.A.E., A.M.I.B.A.E.
Ahmad bin Jamal.
N. Kanagaratnam.
One vacancy.

Asst. Agricultural Officer:—
B. Rengaswamy.

PUBLICATIONS BRANCH

Publications Officer:—(*Vacant*).
Mrs. J. Wilson, B.A. (Oxon) (*Temporary*).

Librarian:—
P. J. Verghese.

FIELD BRANCH (contd.)

SELANGOR: *State Agricultural Officer*:—
H. D. Matheson, B.Sc., D.T.A.
Agricultural Officer, Coast (North):—
Vacant.
Asst. Agricultural Officer:—
Zakaria bin Abdul Rauf, P.J.K.

PAHANG: *State Agricultural Officer*:—
Omar bin Buyong, B. Agric. (*Acting*).
Agricultural Officer:—*Vacant.*
Asst. Agricultural Officers:—
Pahang North—
Ng Ngok Wah.
Pahang East—
Mohd. Muda bin Mahmood.
Agricultural Asst. i/c F.E.S.
Cameron Highlands—
T. Sockalingam.

NEGRI SEMBILAN:
State Agricultural Officer:—
G. F. Darnell, B.Sc. (Agric.), Dip. Agr. (Cantab.), D.T.A.
Asst. Agricultural Officer—Vacant.

MALACCA: *State Agricultural Officer*:—
G. F. Darnell.
Asst. Agricultural Officer:—
Hj Ali bin Mohd. Salleh.

JOHORE: *State Agricultural Officer*:—
P. Class, B.Sc. (Agric.), D.T.A.
Agricultural Officers:—
Johore Central—
Mohd. Ridzuan b. Mohd. Noh, B.Sc. (Belfast).
Johore West—Vacant.
Asst. Agricultural Officer, Johore South:—
Tan Guan Chye.

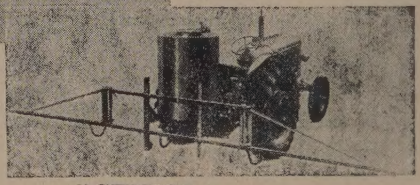
AGRICULTURAL EDUCATION BRANCH

Principal, College of Agriculture, Malaya:—
Chew Hong Jung, B.Sc. (Hons.), B. Agric.
Senior Lecturer:—
Khalid bin Abdul Rahman, B.Sc. (Agric.).
Registrar and Bursar:—
Yap Chin Hee.
Assistant Lecturers:—
G. R. Kurup, B.A.
Abdul Hamid bin Haji Hussein.
Haji Abu Hassan bin Sidong.
Abu Bakar bin Mohd. Tahir.
Tamin bin Hussain.
Mrs. V. Thomas, B.Sc., M.Sc. (Madras), (*Temporary*).
Mrs. M. Joseph, B.A. (Madras), (*Temporary*).

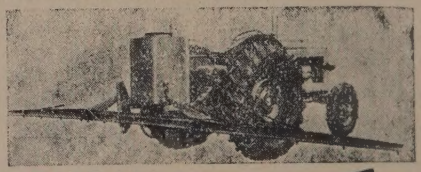
* Seconded to Malayan Agricultural Census Division, Ministry of Agriculture.

FOR BETTER CROPS and
WEED DESTRUCTION

"JUNIOR" MODEL



"SENIOR"



"STANDARD"

No agriculturist can afford to ignore the increased yields and better crops which result from the application of modern spray materials. In their Cropguard range, Ransomes offer machines which are unsurpassed for efficient and economical spraying. Trailed and mounted models are available.

Write for illustrated literature showing this fine range of sprayers

Ransomes

CROPGUARD SPRAYERS

Famous Throughout The World For Agricultural Machinery

SIME DARBY TRACTOR DIVISION,

P.O. Box 252, KUALA LUMPUR. Tel. 88911/8.

RANSOMES SIMS & JEFFERIES LTD., IPSWICH, ENGLAND

A simple choice

Good or bad trees—many factors decide the final yield, but one thing is certain, land for replanting must be cleared of lallang, or the growth of young trees is retarded and the yield reduced. The best and safest way to eradicate lallang is by spraying and wiping with . . .

SHELL LALLANG OILS

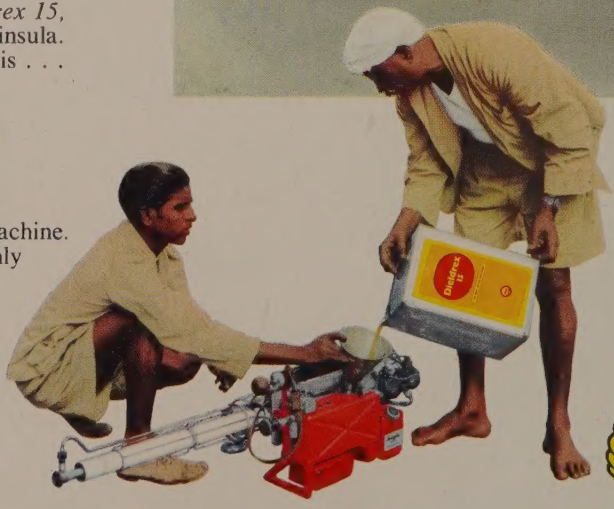
SHELL

Pest control – suddenly

To obtain immediate control of insect vectors of disease, a fine fog of insecticide dispersed over a wide area is the only answer. A fog is also effective in clearing a building of insects quickly.
The effective insecticide is *Dieldrex 15*, already proven in the Malay Peninsula.
The machine to provide the fog is . . .

swingfog

the versatile pulse-jet fogging machine. Portable, simple to use, thoroughly effective; hundreds are in use in Malaya. For details of independent trials conducted by public health authorities, write to Malayan Fertilisers Limited, P.O. Box 157 Kuala Lumpur; Sole Agents for Swingfog in this area.



SHELL

DIELDREX 15

the ideal estate insecticide.

Spray with DOW DOWPON to kill unwanted grasses

Cutting of weeds with a parang leaves the roots strong and healthy to re-sprout in a short time but DOWPON penetrates through the leaves reaching the deepest roots, KILLING the entire plant.

DOWPON

- *is not poisonous for human beings or livestock*
- *does not require special permits or handling*
- *eliminates expensive weeding*
- *requires only one application; lasts up to Six months*
- *controls Annual and Perennial Grasses and grasslike weeds, including lalang.*

MALAYAN FERTILISERS LIMITED

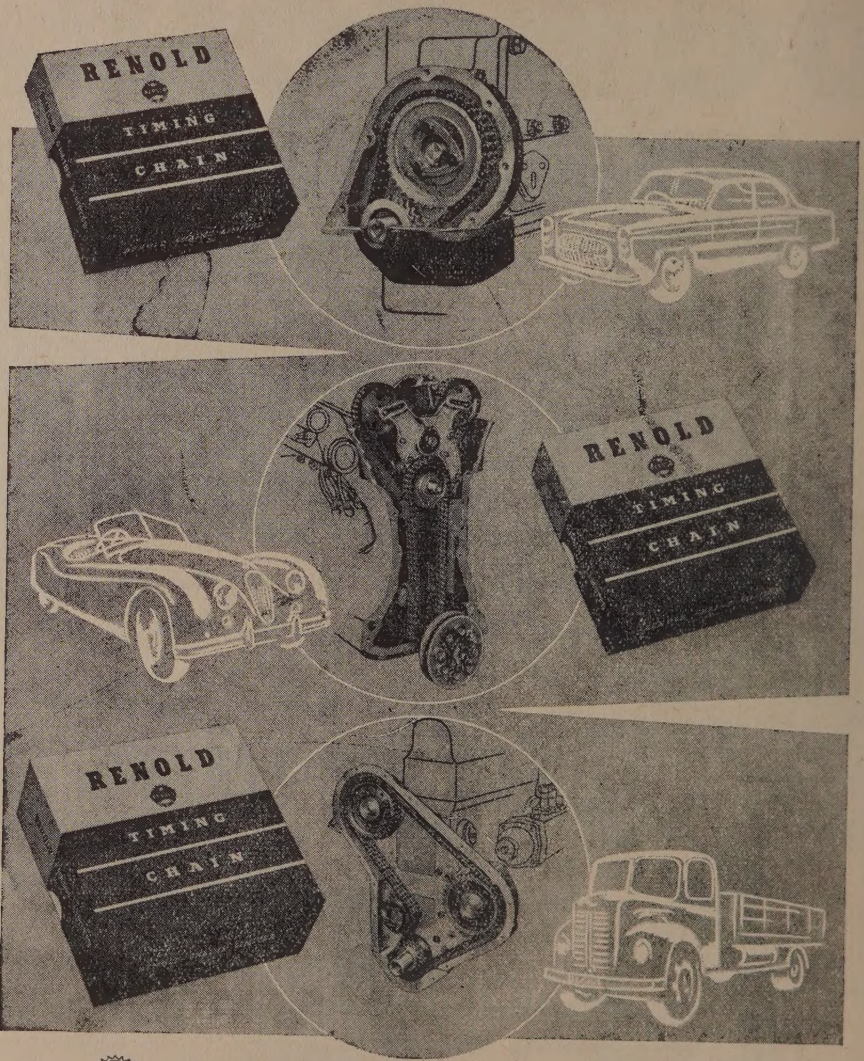
Kuala Lumpur - Port Swettenham - Prai

Alsa available from all hardware dealers,

SIME DARBY (SINGAPORE) LTD.

and SIME DARBY (BORNEO) LTD.

RENOLD TIMING CHAINS



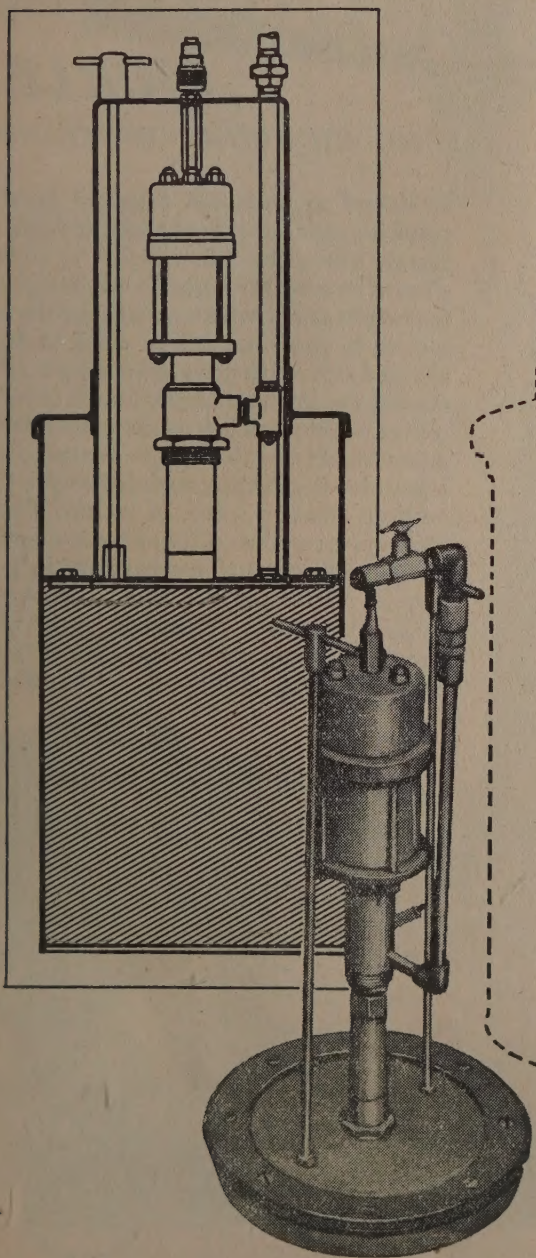
RENOLD CHAINS LIMITED • MANCHESTER

Sole Agents

UNITED ENGINEERS LTD.

SINGAPORE — K. LUMPUR—IPOH— PENANG—MALACCA—SKANDAAN

WAKEFIELD



FLOATING GREASE PUMPS

The problem of handling heavy greases has now been solved by the new range of WAKEFIELD FLOATING GREASE PUMPS. These pumps are attached to the factory-filled containers and literally "float" upon the grease. In operation, they "suck" their way downwards with a complete absence of chanelling and cavitation and clean the sides of the containers as they descend.

FEATURES

Deliver grease in factory fresh condition — absolutely no risk of contamination.
Enable grease levels in containers to be checked at glance — height of pumps within packages instantly show how much lubricant remains.
Eliminate messy and time-consuming handling of grease.
Design ensures complete evacuation of package.
Easy to attach, easy to remove.

WAKEFIELD
LUBREQUIPMENT

There is more for your money in the

ALLEN JUNIOR SICKLE

than any other machine

Designed to meet the toughest local condition and capable of tackling really rough work, the Allen Sickle is in a class of its own. Micrometer adjustment for height of cut, which cannot slip once locked in position, allows work to be carried out with precision under all conditions. A simple draw bolt is fitted for easy and quick belt adjustment. The Allen Sickle has the unique feature of being able to cut clear outside its wheels on both sides to a full 24 inches. The kick starter makes starting simple and immediately the well powered and fully proved Villers MK12 120 cc engine jumps into life. Although it is so strong, powerful and versatile the Allen Sickle is light and easy to handle.

A MATTER OF BALANCE

Experience and experiment in Malaya demonstrate and confirm that different plantation crops require different ratios of nutrients for optimum growth. Nitrogen may be ineffective unless applied with phosphate or, perhaps, potash. Excess applications of magnesium can lead to potash deficiency and excess potash, similarly, produces symptoms of magnesium deficiency.

It is risky, even dangerous, to use unbalanced fertilizer mixtures.

I.C.I. (Malaya) Ltd. with the facilities given by modern mixing plants can offer you any compatible fertilizer mixture you should use.

ICI

FOR FERTILIZERS

NEW USE FOR OLD BRUSH

From the size of the brush it looks like a case of "sending a boy on a man's errand" but at least he is using the right product on this worn out old tree.

Why ?

'Cock's Head' Brand Treekiller when painted around the full circumference of the tree to a height of 15 inches should kill a rubber tree within 4 to 5 months after application.

But isn't 2,4,5-T a latex stimulant ?

Yes indeed. Frequently, but by no means always, the increased flow of latex following application of the treekiller will more than pay the cost of the treatment.

'COCK'S HEAD' BRAND PRODUCTS

I. C. I. (MALAYA) LTD.

MALAYAN AGRICULTURAL JOURNAL
Vol. 42, No. 2, 1959

Corrigenda

Page 53, para 2 line 14 :	"The cultivated rambutan....." should read "According to Lambourne (2) the cultivated rambutan....."
Page 66, Table IIA, Variety:	"R. 16" should read "R.10".
Page 102, para 3 line 3 :	"Serendah Kuning 48" should read "Seraup Kechil 48".
Page 111,para 2 line 6 :	"1949" should read "1940".

THE

Malayan Agricultural Journal

Edited by the Publications Officer
with the assistance of the Publications Committee.

Vol. 42, No. 3 **1959**

Page

Editorial 123

ORIGINAL ARTICLES

Oil Palm Selection and Breeding: A Progress Report. *By A. V. Haddon, B.Sc. (Hons.) Dip. Agric. Sci. (Cantab.) and Y. L. Tong* 124

Visual Symptoms of Major Nutrient Deficiencies of the Singapore Spanish Pineapple. *By K. Kanapathy, B.Sc. (Hons.) (Annamali), M.Sc., A.R.I.C.* 157

Notes on Current Investigations and Extension Work, July to September, 1959 161

STAFF NOTES

Awards, Promotions, etc. 172

STATISTICS

Market Prices and Production for Selected Agricultural Products 173

Meteorological Summaries 178

THE MALAYAN AGRICULTURAL JOURNAL

The Journal which is published quarterly, is designed to present — as far as possible in non-technical terms — the results of the agricultural research, investigation and extension work performed by the Department of Agriculture and it draws attention to the results of work of a similar nature in other countries.

The price of the Journal is $2/- per copy or $8/- per annum, post free, in Malaya; it is $8.50 or £1 sterling, post free, outside Malaya.

The Journal and other publications may be obtained from the Department of Agriculture, Kuala Lumpur, Federation of Malaya, or from the office of the High Commissioner for Malaya in the United Kingdom, Malaya House, London, W.1.

COMMITTEES OF THE DEPARTMENT

The Standing Committee on Investigations:

The Deputy Director of Agriculture. **(Chairman).**
The Assistant Director of Agriculture. (Research).
The Assistant Director of Agriculture. (Field).
The Senior Agronomist.
The Agricultural Officer, Headquarters. (Secretary)

The Publications Committee:

The Director of Agriculture, Federation of Malaya. **(Chairman).**
The Deputy Director of Agriculture.
The Assistant Director of Agriculture. (Research).
The Assistant Director of Agriculture. (Field).
The Senior Agronomist.
The Publications Officer. **(Secretary).**

The Examinations Board:

The Deputy Director of Agriculture. **(Chairman).**
The Assistant Director of Agriculture. (Research).
The Assistant Director of Agriculture. (Field).
The Senior Agronomist.
The Principal, College of Agriculture, Malaya.
The Higher Executive Officer. **(Secretary).**

The Advisory Council, College of Agriculture, Malaya:

The Hon'ble Dato Haji Mohamed Noah bin Omar, D.P.M.J., P.I.S., J.P. (Chairman)
Secretary to the Minister for Agriculture.
The Director of Agriculture, Federation of Malaya.
The Director, Rubber Research Institute of Malaya, Kuala Lumpur.
The Principal, Sultan Idris Training College, Tanjong Malim.
The Principal, College of Agriculture, Malaya.
The Hon'ble Enche Hashim bin Awang, J.P., Tassek Glugor.
The Director, Veterinary Services, Federation of Malaya.
Secretary of the Alumni Association, College of Agriculture, Malaya.
The Hon'ble Mr. Yap Kim Hock, Johore Bahru.
Datok Jaafar bin Mampak, Dato Wangsa, Kuala Trengganu.
Mr. Chan Hin Cheung, Kuala Lumpur.
Enche Jamaludin bin Aji, Seremban.
Enche Ismail bin Yusoff, Kuala Lumpur.
The Representative of the Rubber Producers' Council.
The Registrar and Bursar, College of Agriculture, Serdang. **(Secretary).**

The Efficiency Bar Board:

The Deputy Director of Agriculture. **(Chairman).**
The Hon'ble State Secretary, Perak.
The Hon'ble State Secretary, Negri Sembilan.
The Representative of the Federal Government.
The Higher Executive Officer. **(Secretary).**

THE

Malayan Agricultural Journal

Vol. 42, No. 3, 1959

EDITORIAL

The importance of oil palm in the Malayan economy is considerably less than rubber as a means of earning foreign exchange, but the crop gives a good net return per acre and is well suited to the Malayan climate and soil conditions; it is capable of producing more oil per acre than any other oil-producing plant.

At the present time, production is entirely in the hands of heavily capitalised estates. An economic return cannot be achieved by small-scale enterprises because of the technical difficulties involved in processing the palm fruit. In Africa, palm oil is produced by smallholders using primitive hand presses, but the product is of inferior quality, much oil is wasted and the return per acre is low. The cost of erecting and operating a palm oil factory with modern machinery is so great, that only a very large throughput of fruit can make the enterprise an economic proposition. This necessitates either a large acreage of oil palm under estate management, or a large acreage of small-holders' plots under co-operative management.

The Department of Agriculture and commercial growers have, for many years, been operating research programmes with a view to breeding an oil palm that will mature quickly, produce good yields of fruit near the ground (to facilitate harvesting), with high oil content, etc. In 1956 an agreement for cooperative breeding work on oil palm was concluded between the Department and the United Planting Association of Malaya. In this issue, which is primarily devoted to oil palm, Mr. Haddon reviews progress made in what is essentially a long term research programme.

It is anticipated that results of this research will not only benefit the large producers, but will be of great value in the development of smallholders' oil palm cooperatives, the first of which is now being organised in Johore.

Visual symptoms of Nutrient Deficiencies in Pineapple. Mr. Kanapathy has contributed a useful guide to the visual recognition of the more important nutrient deficiencies found in pineapples of the Singapore Spanish variety. He describes the experiments done to isolate the deficiencies, and the coloured illustrations and descriptions provide a rapid means of identifying them.

OIL PALM SELECTION AND BREEDING: A PROGRESS REPORT

BY

A. V. HADDON *(Ag. Senior Botanist)*

and

Y. L. TONG *(Agricultural Assistant)*.

Introduction

Selection trials of oil palms were first put down by the Department of Agriculture at Batu Tiga about 1903, but unfortunately lack of continuity in the work hindered the development of proven seed lines. A fresh start was made by Jagoe in 1929, and this set the breeding programme moving in the right direction so that the impetus given during the last few years by the initiation of the "Co-operative Breeding Scheme" has placed it in a healthy position. The Scheme has not only enabled the Department's work to continue, when it otherwise would have come to yet another halt, but is leading to much better integration with the research carried out by independent organisations in Malaya.

Policy

When the Batu Tiga trials were planted, and until quite recently, it was common for estates to plant large commercial areas of oil palms with seed which was either of virtually unknown origin or which had been collected from the best-looking palms in an avenue or high yielding field. This no longer happens; the potential value of pedigree seed from properly selected palms is appreciated, and the demand for it can now be met by the commercial seed growers in Malaya. The Department has no intention of competing with the seed growers and merely aims to improve the quality of growers' seed by making available to them the valuable breeding material which has been collected on Federal Experiment Stations. At the same time it is hoped to carry out investigations into fundamental aspects of oil palm breeding by planting this material on the growers' estates in the form of progeny trials. The potential ability of the Department to produce seed for commercial planting will, of course, not be reduced in any way.

Genetic Stock

By West African standards, the variability within the Department's foundation stock of breeding material might not be considered great, but even in the relatively homozygous "Deli" palm there is now a considerable degree of variability—as shown by the collection at Serdang of Dumpy and other inbred lines. A complete account of the origin of the Serdang Deli dura collection and the "Dumpy" dura palm has been given in this journal by Jagoe (1), (2), but he does not mention that at Serdang there are also the remnants of an old planting of imported West African

varieties, which includes, in particular, three fertile pisifere palms and eight mantled-dura palms.

More recent importations from West Africa have included small quantities of pisifera pollen which were required for breeding tenera palms and some seeds of varieties not previously represented in Malaya. A complete list of imports made by the Department since 1946 is given in Table I. Tables I—XVII are at the end of this article.

Progeny Selection

Deli dura F_1 progeny trials (at F.E.S., Serdang)

There are now only two mature progeny trials growing at Serdang and both of these were planted by Jagoe during the years 1937-40 with selfed lines from the dura palms he selected on Elmina Estate. There are also unreplicated plots of other Elmina lines, including Dumpy and (Dumpy x Tall), which were planted about the same time. Records from all these palms are summarised in Table II and Figure 1 from which it is clear that progenies E.268 and E.211 are outstanding for total yield but there are other progenies with desirable characteristics, such as E.200 with its high "fruit-to-bunch ratio".

The Dumpy palms in Field 4 are planted in two separate rows of eleven palms each, with tall palms on both sides of each row. They have yielded consistently less than the Dumpies planted in a block of four adjacent rows, in Field 3A, and it is not certain if soil, palm competition, or even nursery selection is responsible for this.

The two (Dumpy x Tall) progenies, also planted in blocks in Field 3A, have yielded as well as any Elmina progeny and have given the largest and best quality bunches.

Earlier progeny trials at Serdang were planted about 1930 with pedigree seed from various selected palms which grew in an avenue on the Station. The control, for these trials, was open pollinated seed collected at random from the avenue. When it was found that the 'controls' consistently yielded as much as the 'selected' progenies further investigation seemed unwarranted, and the trials have now been abandoned.

Similar "Avenue" seed was sent to the West African Institute for Oilpalm Research, (W.A.I.F.O.R.) Nigeria, and Toovey and Broekmans have reported that "generally speaking, there is an inverse relationship between yielding capacity of the parent trees in Malaya and the yield of their progeny in Nigeria" (3). The Serdang records confirm the W.A.I.F.O.R. result (Table III) but a more correct conclusion is probably that the yields of parent palms in a fertile avenue and their progenies in an infertile field are inversely related.

Deli dura F_2 progeny trials (on F.E.S. Jerangau, and estates)

During the three years, 1951-53, a total of some 400 acres of progeny trials and observation plots were planted at F.E.S., Jerangau,

and on various oil palm estates. Of this area about 330 acres were planted with F_2 Dumpy or semi-Dumpy dura material descended from the Serdang palms.

Dumpy dura palms

It is too soon to comment on differences between Dumpy progenies under trial (Tables IV & V) but it is only too evident that in general these F_2 Dumpy duras are slow to come into bearing, give few bunches and, like their parents, have a low proportion of fruit-to-bunch.

The figures given in Table VIII clearly show that Dumpy dura palms have yielded less than adjacent estate dura palms of a similar age wherever they have been grown and these figures are confirmed by the two formal trials of Dumpy versus normal dura (Tables IX & X). During the first two years in bearing selected normal dura palms can be expected to yield at least 50 per cent more than Dumpy duras.

Semi-Dumpy backcrossed to Dumpy dura palms

The yield from "back-cross" palms appears to be much better than that from Dumpies. These are not back-cross progenies in the true sense, since the Serdang Dumpies were used as parents instead of the original Elmina Dumpy palm.

Variation of yield and bunch size between various progenies is considerable (Tables VI & VII) but unfortunately this type of palm is not compared with normal dura palms in any formal trial. In an observation block (0.4) on fertile alluvial soil, Dumpy back-cross palms have given more than 10 tons/acre of F.F.B.* Under less fertile conditions (0.19) early yields were about 6.5 tons/acre and on poor soil (0.6) only 6 tons/acre.

Semi-Dumpy (sib) palms

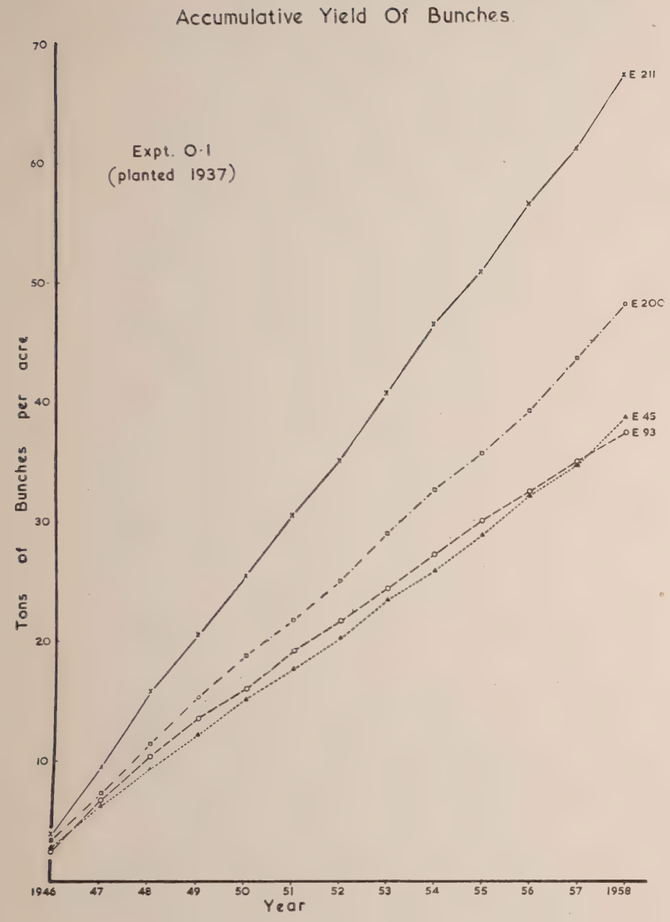
Except for one progeny, planted in trials 0.4 and 0.8, this type of progeny is not represented in the field by mature palms. In the unreplicated plot in 0.4, the progeny (14.2 x 10.8) has yielded much less than the Dumpy-backcross palms, but in the replicated trial (0.8) the same progeny has yielded comparatively well. The absence of Dumpy segregants in this progeny, either very short in height or very large in girth, is possibly due to the small population of only 35 palms (Fig. 3).

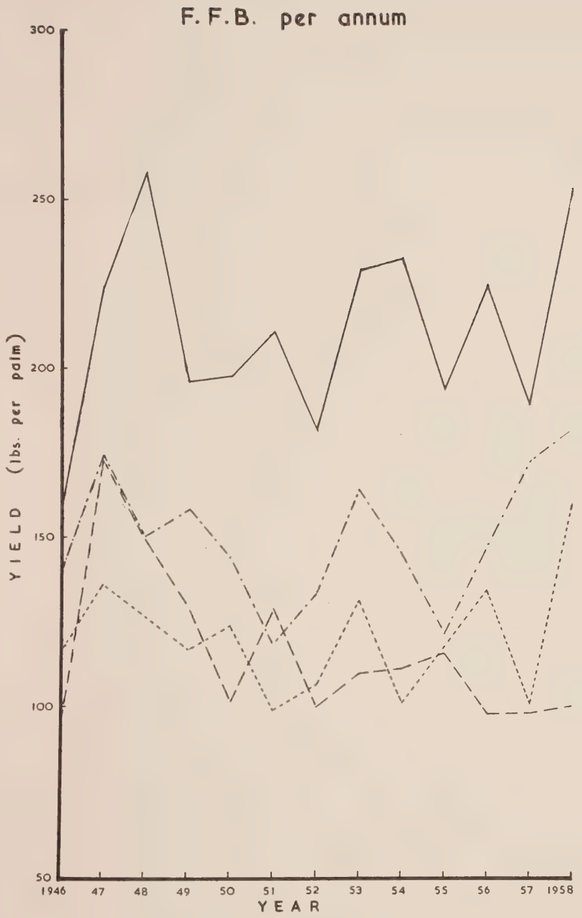
Table XVIII

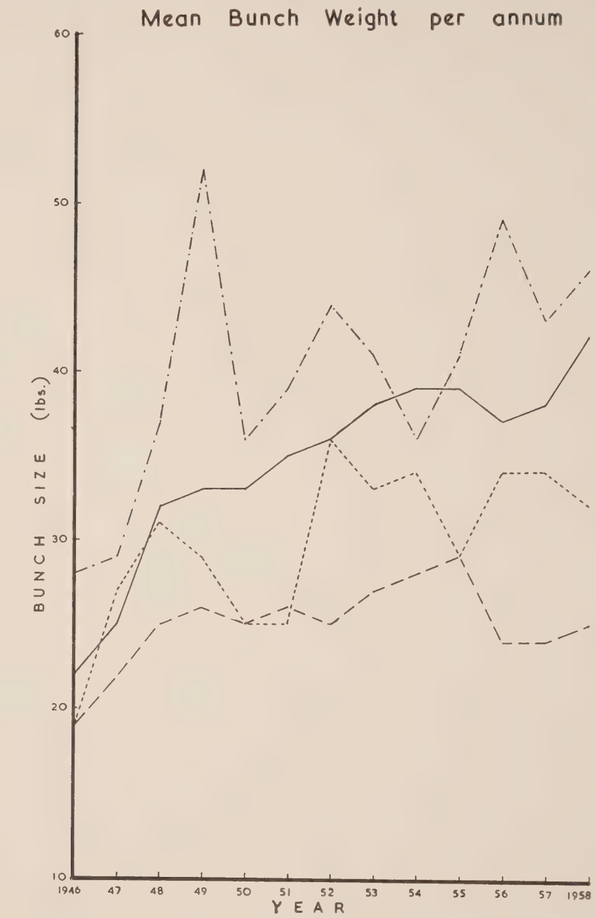
Trial No.	Yield of semi-Dumpy sib (F.F.B. tons/acre)				Yield of other dura (F.F.B. lb./acre)			
	1956	1957	1958	Mean	1956	1957	1958	Mean
0.4	8.7	8.7	8.0	8.5	8.6	10.1	9.5	9.4
0.8	4.1	7.5	8.1	6.6	4.4	6.7	7.7	6.3

* F.F.B. = Fresh Fruit Bunches.

FIG. 1 A
Deli Dura at F.E.S. Serdang—Bunch Yield Weight and Number per Annum.
Expt. 0.1







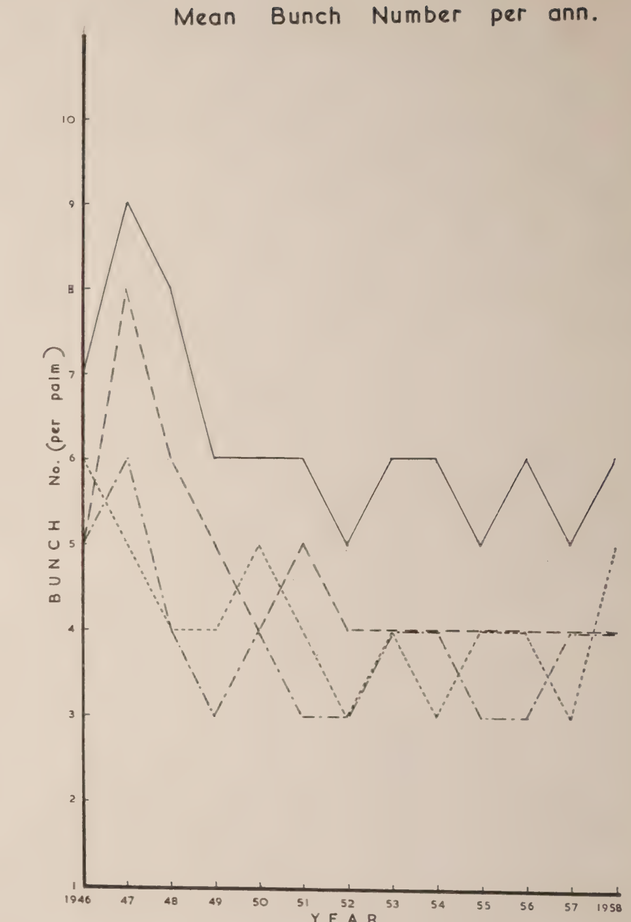
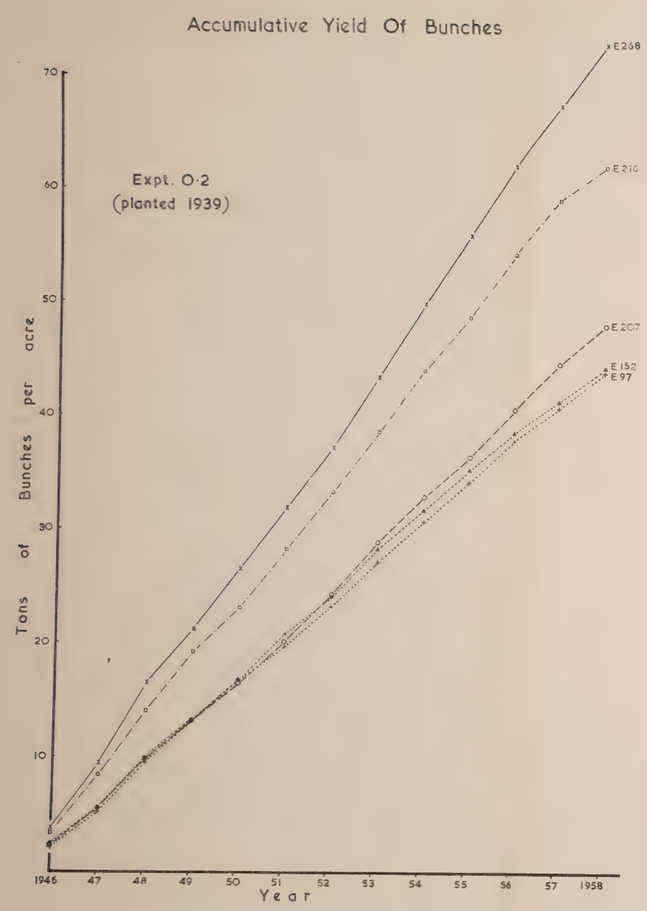
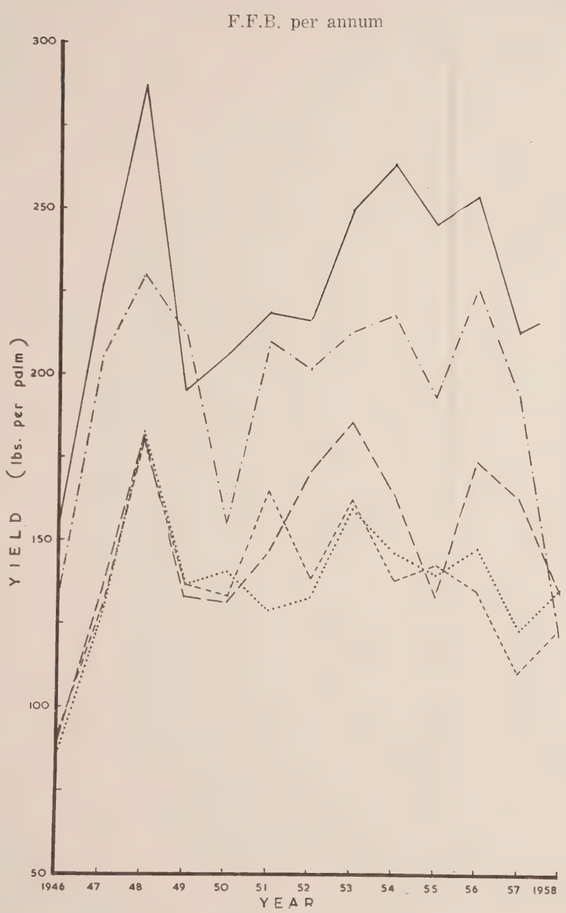
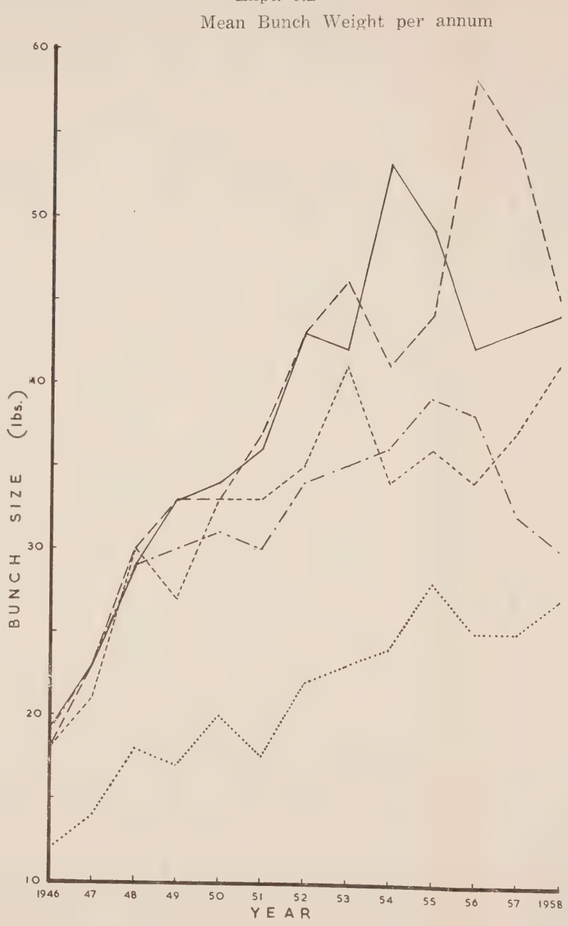
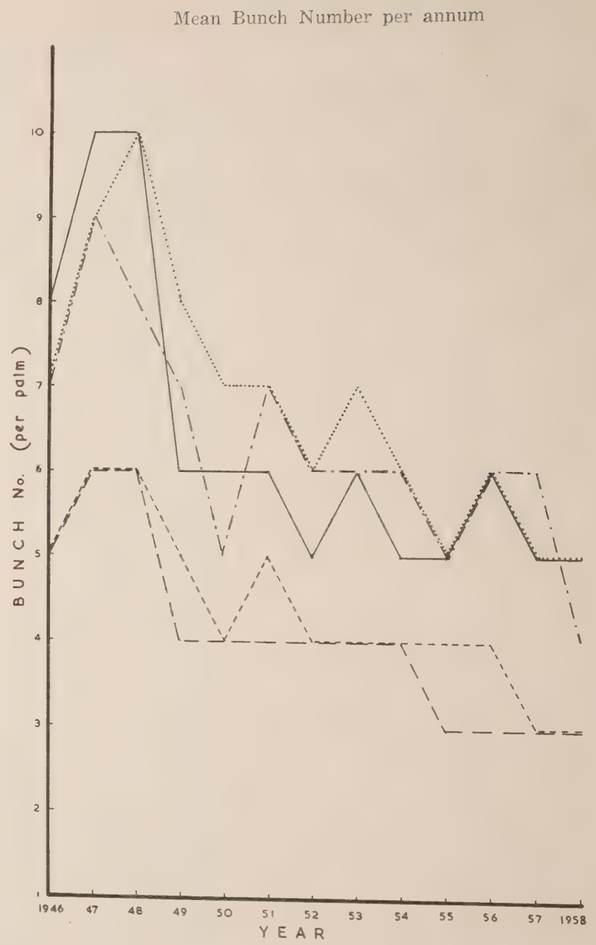


FIG. 1 B
Deli Dura at F.E.S. Serdang—Bunch Yield Weight and Number per Annum.
Expt. 0.2









Normal Deli dura palms

Trial 0.8, planted at F.E.S., Jerangau, in November, 1953, is probably the only formal experiment in bearing which compares Deli dura material from three distinct genetic stocks (Table XI). It is quite clear that, although only the pair of progenies from estate X are closely related, differences between stocks are far greater than differences between progenies of the same stock. This is apparent in the yield records and can also be found in the variation of yield with season and even in the colour of foliage.

The precocity of the two progenies from estate Y was so marked that they could have been brought into bearing at least six months earlier than the Serdang strains.

Table XIX

0.8 Deli dura progeny trial

(Crop for the first three months in bearing)

October—December, 1955.

Variety		F.F.B. (lb./acre)	No. of bunches (acre)	Mean bunch weight (lb.)
Estate X	A	2,148	277	8
	B	2,235	287	8
Estate Y	C	3,105	359	9
	D	4,230	476	9
Serdang	E	845	77	11
	F	1,054	120	9
S.E. (15)		311	30	0.6

TENERA PROGENY SELECTION

West African tenera

The West African collection planted at Serdang in 1927 included a number of tenera palms but most of these were removed, with the rest of the collection, to make way for a new trial in 1950.

The yields from these tenera palms was thought to be very poor, but this does not appear to be a valid conclusion if the records are compared with those from later plantings of Deli dura palms in adjacent fields.

During their seventh year in bearing, the teneras and pisiferas together yielded 121 lb./palm of F.F.B. compared with 131 lb./palm from neighbouring Deli dura at the same age. Some of the individual teneras were extremely good, considering the poor fertility of the soil in which they grew. During 1939 and 1940 palm No. 29/23 yielded 383 lb./ann. F.F.B., with 88 per cent mesocarp on fruit.

No (DP) * tenera seed has been imported from West Africa by the Department, since it was considered more important to first increase the population of pisifera palms by planting (TT), (TP) and (PP) seed.

Malayan tenera

Since the Deli palm is known to exist only in the dura form, all tenera (DP) seed produced in Malaya by the Department is really "semi-Deli". The three old surviving fertile pisifera palms at Serdang have provided the bulk of the pollen for DP pollinations but additional small quantities have been obtained from various West African sources.

There is little reason to doubt that the Beirnaert and Wanderweyen theory of tenera inheritance (4) is just as applicable to the Deli dura palm as it is to the West African dura. There are now a number of records, including some from West Africa, to prove that almost pure tenera stands can be obtained from semi-Deli (DP) seed (eg. Table XIII: progeny 3.5 x 27B) and the high proportion of dura palms found in some Malayan (DP) progenies may be attributed to a faulty seed production technique.

Normal Deli tenera

Trial 0.18, planted at F.E.S., Jerangau, in 1953, is the only "normal tenera" trial put down by the Department which has yet come into bearing. The trial is largely a failure since not one of the 72 supposedly 'tenera' palms has actually produced fruit of the tenera type. All palms in the two 'tenera' families bear fruit of the typically thick shelled West African dura type, which indicates that the imported pollen used in their breeding was at least viable. Other pollinations carried out at much the same time by exactly the same technique, but using only Serdang palms, have now been shown to give tenera progenies containing not more than 25 per cent dura contamination and usually very much less.

The yield of bunches obtained during the first two years of bearing from these two 'dura-in-error' progenies has been high. It can be seen from Table XII that the crop of fruit was as good as that from high quality Deli dura palms although the yield of oil was probably less because of the inferior fruit type.

Dumpy tenera

The majority of the early tenera breeding work was concentrated on the Dumpy palm. Between December, 1953. and December, 1956, there were six trials and Observation Blocks (60 acres) of this type of material planted on estates and Experiment Stations. Records are so far available from only a few of these.

Trial 0.19 planted at Jerangau in December. 1953, (Table XIII) came into bearing in 1957, and to date the yield of fresh bunches from the three Dumpy tenera families slightly exceeds that from the three dura families. This is due more to an increased size of bunch than to a greater number of bunches. The performance of the teneras is the more credi-

* Initials indicate parentage. D = dura, P = pisifera, T = tenera. Thus DP seed originates from a dura palm pollinated with pisifera pollen.

table when it is noted that the Dumpy back-cross palms are probably the best dura material the Department can produce. Bunch analysis records are being collected and the ratio of mesocarp to fruit appears to be extremely good for both dura and tenera palms.

Observation Blocks (0.20 and 0.21) were planted in December, 1953, partly with tenera seedlings which remained in the nursery after planting 0.19. They are growing slightly less well than those at Jerangau, but rather surprisingly, the imported West African pollen which failed to produce tenera palms for trial 0.18, is associated here with one small progeny containing 70 per cent teneras. Crop records are given in Table XIV.

There has been no difference observed in the habit of Dumpy tenera and normal tenera palms; they mature at the same age and have a similar girth. Few data on comparative annual height increments are yet available, but in experiment 0.19 the Dumpy back-cross dura palms are taller than the Dumpy teneras.

Individual Palm Selection

Since the breeding programme was aimed at a fundamental study of oil palm genetics and not merely the immediate production of high grade seed, a high calculated yield of oil was only one of the characteritics used for the selection of individual palms. Having set certain minimum standards of selection to reduce the population to manageable proportions the remaining palms were considered individually. This would have been relatively simple to do for the 61 Dumpy dura palms at Serdang were there not so many extraneous factors to consider in their case. Jagoe has pointed out (2) that, for this reason, selection was made on as wide a basis as possible. and while most progenies are descended from only eight 'first-class' Dumpies, the total number represented in progeny trials is 20.

In setting the minimum selection standards, considerable allowance was made for the probable greater influence of environment on yield than on other characteristics such as fruit quality and height (Fig. 6). The effects of seasonal and cyclic factors influencing yield were largely attenuated by calculating the mean over ten years, but it was appreciated that the cumulative effects of minor variations in soil and inter-palm competition become more important with time and due account was taken of the early records. (Fig. 5 shows that, for progeny E.200, the highest yielding palm in 1946 was still the highest in 1958.)

Minimum Selection Standards

Yield:	70% of field mean
Fruit to bunch ratio:	55%
Mesocarp to fruit ratio:	60%

The normal dura palms were more numerous and it was possible to set higher bunch quality standards for the lower yielding palms according to a sliding scale. This is illustrated in Fig. 2 where it can

be seen that selection of palms yielding less than the field mean was confined to those having more than 70 per cent mesocarp on fruit. At the lower levels of mesocarp percentage, the fruit-to-bunch ratio was also progressively raised.

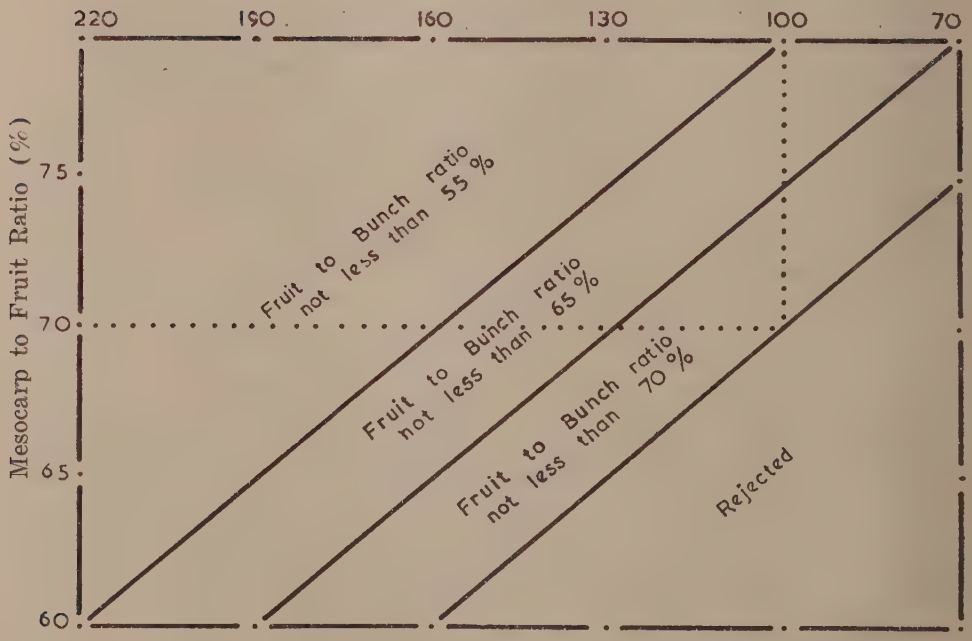
It must be emphasised that the selection standards were designed to fit these particular palms and were adjusted so that no outstanding ones would be excluded.

FIG. 2

Classification of Selected Serdang Dura Palms.

YIELD

(F.F.B. as a percentage of field mean)



Having tabulated the palms in this way, and added other data including relative bunch number, * pedigree, height and actual percentage fruit on bunch, it was easy to pick out those in, say, the high yield and low mesocarp category for hybridisation with, perhaps, a palm in the low yield high mesocarp group.

* Relative Bunch Number $= \left(\frac{\text{B. No. of palm}}{\text{Field Mean B. No.}}\right)\% - \left(\frac{\text{Yield of Palm}}{\text{Field Mean Yield}}\right)\%$

The Oil Palm Co-operative Breeding Scheme

Progeny trials are still the only really satisfactory means of selecting the best seed mother palms but they demand quite large areas of uniform land and a considerable amount of supervision. The Department, being unable to meet these requirements in most circumstances, was compelled to seek the co-operation of the management of oil palm estates who stood to gain by planting progeny trials on their land. At first, in the years 1951-53, when most of the Dumpy dura blocks were put down, the composition and location of a trial was often not settled until after the nursery seedlings were ready to be transplanted. This undesirable state of affairs, which largely prevented any planned approach to the problem of oil palm selection, was suddenly changed in July, 1956, by the inauguration of the Co-operative Breeding Scheme. The purpose of the Scheme was that each of four "Host Estates", representing the industry in Malaya, would make available to the Department of Agriculture 200 acres of land for planting with formal experiments by 1960. Moreover, as each of these four Host Estates have their own research programmes with the staff to carry them out, it was agreed that co-operation was not to end merely with the provision of land but that the estate staff would actively assist the Department's Plant Breeder and that all research officers concerned with the scheme should meet at least once a year to review progress.

The first of these meetings were held on 16th July, 1956, and the breeding programme, which is described below, was formulated. In order to facilitate comparisons between one location and another it was decided that all trials should have a simple robust design such as a Randomised Block with five replications and 4 x 4 palms per plot. Duplication and synchronisation of trials was considered to be impracticable except on a broad scale and this has proved to be true.

At subsequent meetings in 1957 and 1958 it was agreed that the original programme using Serdang palms should be expanded to include comparisons of progenies originating from Serdang with progenies produced by the Host Estates themselves. Thus co-operation has now reached the level where pollen from Serdang has been used to pollinate palms on all four Host Estates and the seed so obtained shared between estates for testing in simultaneous trials.

Because of poor seed germination and high casualty rates in some nurseries, the number of progenies reaching the field has been less than anticipated. By December, 1958, the acreage planted on Host Estates with material actually in trial and excluding guard rows etc. was:

Host Estate	*Acreage planted*
Klanang Bahru (Selangor)	94
Ulu Remis (Johore)	44
Johore Labis (Johore)	42
Jendarata (Perak)	46

With the expansion of the original programme it is anticipated

that almost 200 acres will be planted on each Host Estate by the end of 1961.

Breeding

Early Work

Mention has been made of the early "Avenue" selection and breeding work which was eventually abandoned when the last series of field trials suffered complete neglect during the Japanese occupation, failed to recover afterwards and gave results which were so anomalous that further work appeared likely to be unprofitable.

Fortunately, the trials planted by Jagoe with "Elmina" selections, just before the occupation, recovered from their neglect when brought back into cultivation after the war. The results of these trials so clearly indicated that Dumpy palms were the most promising line for continued research that little attention was paid to the normal "tall" families. The new series of post-war trials planted during 1951, 1952 and 1953 included more than 300 acres of some sort of Dumpy material but hardly ten acres of normal tall dura progenies.

By the end of 1954 it was becoming apparent that F_2 Dumpy palms are slow to mature, but renewed interest in normal duras was mitigated by a rising enthusiasm for tenera palms which had been aroused by news from Sumatra and an estate in Johore, of the very high yields that were being obtained from this variety. The whole breeding programme therefore came under review and it was decided that, apart from the Dumpy out-breeding and selfing work, more attention should be paid to tenera breeding. Normal dura breeding should continue but only to a limited extent. The reason for continuing with dura breeding at all, was to compare tenera with dura under a variety of conditions and because high yielding dura palms will probably always be necessary for the production of tenera seed.

A summary of the new breeding programme was put before the first meeting of the Cooperative Breeding Scheme Technical Committee in July, 1956. It was adopted with some recommendations, and the following summary of the current breeding programme was discussed.

Current Breeding Programme (1956)

(a) *Main Breeding Lines*

- (i) Dumpy dura by selfing, crossing, backcrossing.
- (ii) Dumpy tenera by crossing and backcrossing.
- (iii) Selection of pisifera parents, both dumpy and tall.
- (iv) Exploration of semi-dumpy types.
- (v) Exploration of crosses between dumpy and other short statured types.

(b) *Minor Breeding Lines*

- (i) Exploration of possibilities of tall Serdang dura selections by selfing, etc.
- (ii) Serdang tall tenera.

(iii) Melacococca, including dumpy and tenera crosses.
(iv) Mantled types, both dura and tenera.

Recommendations

(a) that as regard to breeding lines (a) i, iv and v, sufficient work had already been done with the dura material available and that further developments should await the results of field trials now in progress;
(b) that emphasis be laid on the production of parental pisifera material in the first generation by raising F_2's from tenera parents and tenera/pisifera backcrosses ((a) iii);
(c) that the best available tenera and pisifera (both fertile and female sterile) should be obtained, including INEAC *—16R and Sumatran SP540 and that further sources of similar proven material should be sought ((a) ii, iii and (b) iii);
(d) that breeding with tall Serdang dura selections should be aimed primarily at inbreeding for the exploitation of heterosis ((b)i);
(e) that on each host estate a small area (of the order of ten acres) should be established as a genetic collection for study and future development of the scheme; and that these blocks should include such of the following types as can be obtained, *viz. E.melanococca, mantled (diwakawaka)* types, *albescens, virescens* and *idolatrica* ((b) iii. iv).

FIELD TECHNIQUE

Recommendations

(a) that the best available palms should be used as controls in tall palm trials (see preceding paragraph);
(b) that so far as planting material is available, progenies for trial should be about 80 plants in size and that the number of effective replicates should be as many as possible and not less than five;
(c) that within the limits imposed by quantity of available planting material, trials on all host estates should, as far as possible, be identical;
(d) that, where practical, trials on the different estates should be carried out by similar methods, but complete uniformity of methods of husbandry should not be sought, resulting differences being combined with effects of the uncontrolled environment;
(e) that the inclusion of tall and short palms in the same trial should be avoided as far as possible, but where necessary, the method of doing so should be worked out according to the needs of the particular trial.

* INEAC = Institut National pour l' Etude Agronomique du Congo Belge

Some of the breeding lines have been expanded since 1956, to include additional material which has been contributed to the Scheme by, or on behalf of, the participating Host Estates.

Breeding the Dumpy Dura Palm

There was considerable confidence that the bunch characteristics of the Serdang Dumpies could be improved in the next generation either by using as parents only those Dumpy palms with comparatively good quality bunches or by back-crossing the semi-Dumpy palms, with their high bunch quality, to the Dumpy. The sib crosses have proved a failure in this respect but the backcrosses show a distinct improvement in bunch quality and a number of segregants are nearly Dumpy in habit. (Figs. 3 and 4). Backcrossing will continue in the orthodox fashion and may ultimately be successful in producing high yielding Dumpy palms with good bunch quality but on the other hand, the continued inbreeding may again only lead to loss of vigour and yield.

As soon as this last point was appreciated, it plainly became desirable to investigate the effects of out-breeding the Dumpy with other short dura strains. Only four such strains were found, but it proved possible to include all of these in the breeding work thanks to the co-operation of the management of the estates on which they grow.

Strains of Short Deli Dura Palms Other than Dumpy

Johore Labis Estate, Johore. Malaya:	A selected family of short but not Dumpy palms. First generation inbred.
Ulu Remis Estate, Johore. Malaya:	A number of families shorter than average including nine with an annual height increment of less than one foot per annum
Gunong Melaju Estate, Sumatra:	A number of families a little shorter than usual but not Dumpy.
Tumbuk Estate, Selangor, Malaya:	A high yielding block of 18 acres, containing some very tall and some short palms. Pollen was collected from short palms with a large girth.

Sixteen different (Dumpy x Short) hybrids eventually reached the field where they were planted, for comparison, with other progenies of either Dumpy, short or semi-short origin. (Table XV). They were the first to be planted under the Co-operative Breeding Scheme.

In addition to the hybrid short material, each Host Estate has a block planted with selfed seed from five of the best Serdang Dumpy palms. These selfed seedlings may be poor in general, but it is expected that a few very useful segregants will emerge from the total population of more than 3,000 palms.

Evidence from the tenera trials has cast doubts on the accuracy of the pollination technique in use during 1949/50 when the seed was produced for planting 'selfed' progenies which are now in bearing. High yielding segregants in these early Dumpy plantings might well represent

FIG. 3

Segregation of Height and Girth Factors in Dumpy-backcross and Semi-Dumpy Sib Progenies
Expt. 0.4

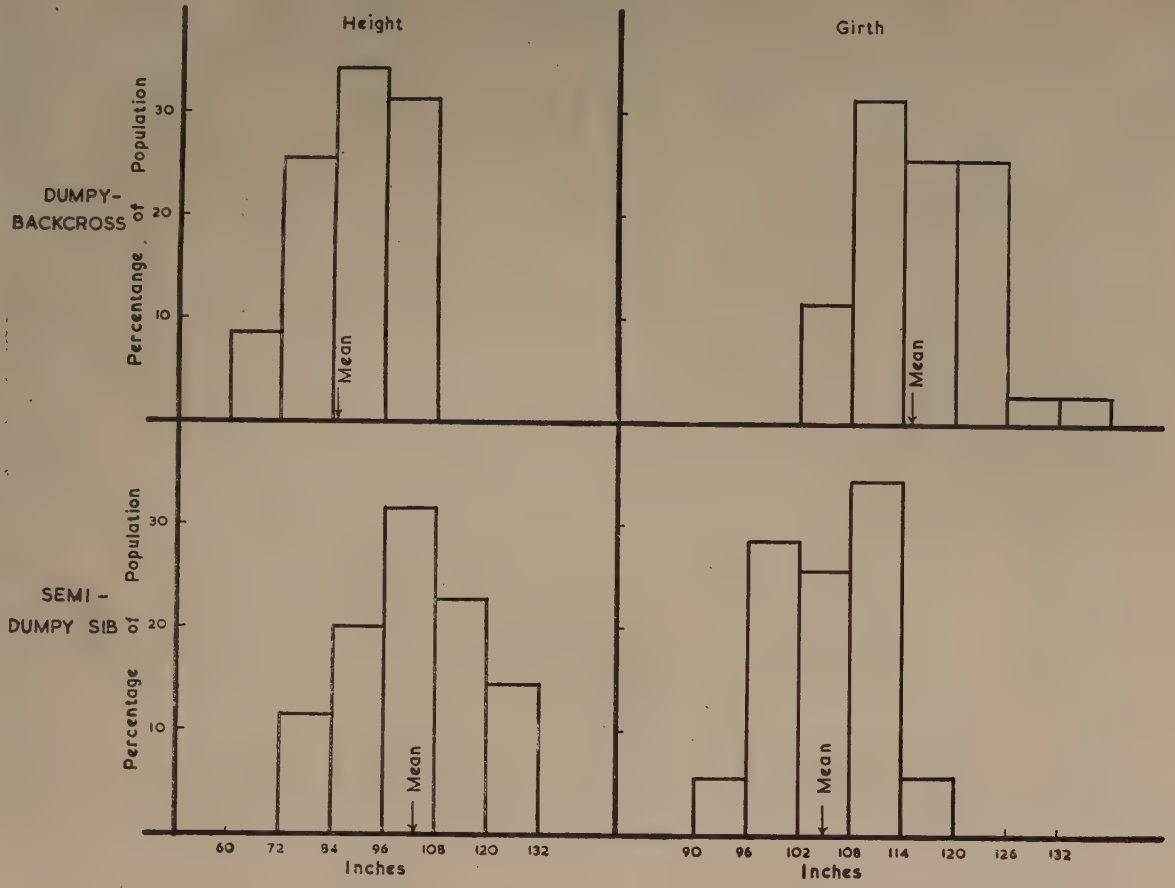
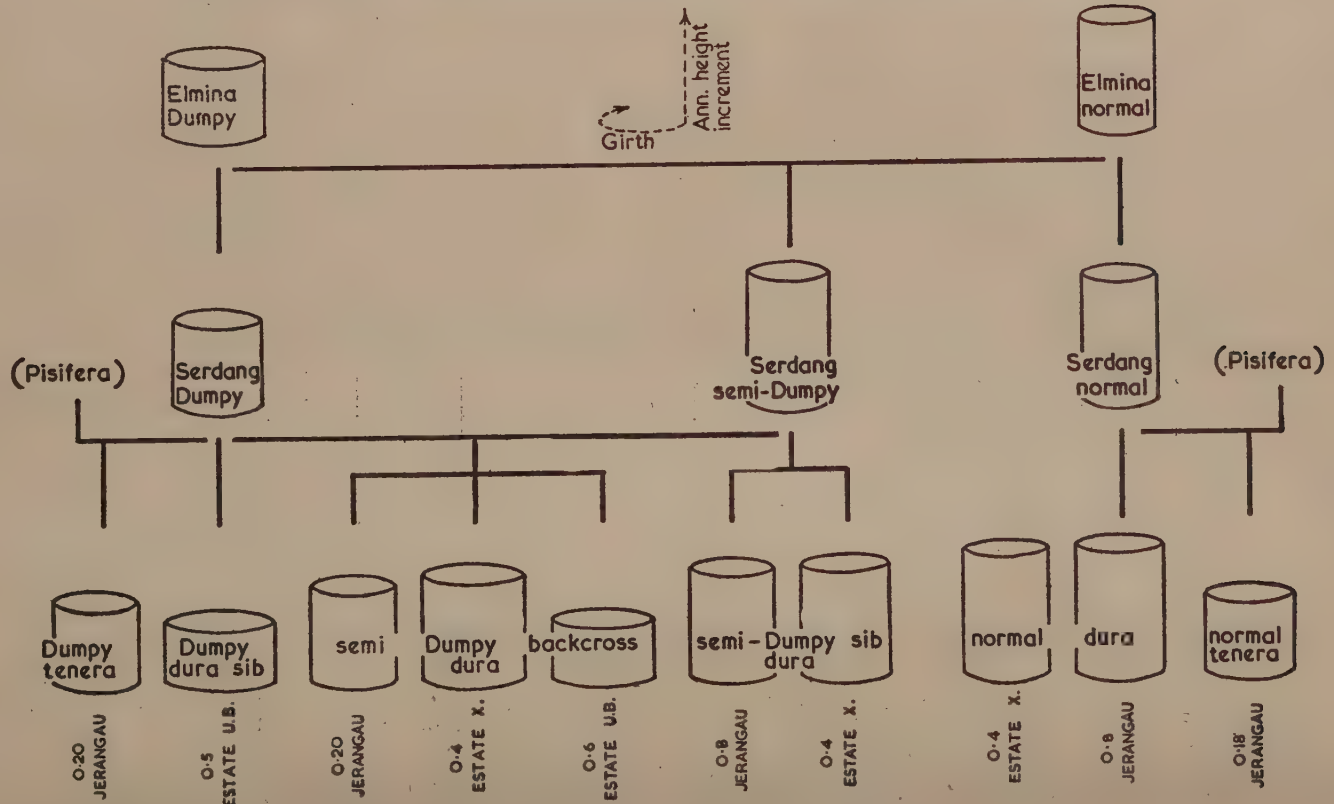


FIG. 4

The Inheritance of Height and Girth in Dumpy and Semi-Dumpy Dura Palms



out-pollinated seed. Since 1955 the technique has been improved and it will be possible to select individual palms from within the new Dumpy-selfed progenies with more confidence in the accuracy of their stated genetic origin.

Breeding the Normal Deli Dura Palm

It has been pointed out that there are a number of outstanding dura palms in the Serdang collection. The aims, in progeny testing these palms were as follows:—

(i) To compare in general, and in particular, dura with tenera progenies.

(ii) To investigate the inheritance of various genetic characteristics affecting yield (eg. Bunch size and number; fruit quality).

(iii) To investigate the effects of inbreeding and cross breeding with particular attention to the potentialities of heterosis.

It was intended that the parents of the dura seed should also be used as mother palms for the tenera seed, and the seed for (i) was to be produced according to a planned system of crosses for (ii).

Mainly because of poor seed germination, the scheme fell a little short of its aim. However, the trials that have been established should give a valid comparison of dura and tenera material in general and at the same time yield considerable information on oil palm genetics. The value of some trials is improved by the addition of a further variety representing the standard planting material being used on the respective Host Estates at the time the trials were established.

These trials could therefore be used for an indirect comparison of the various breeding stocks used by Host Estates but a better and closer comparison was thought to be desirable. Preparations are now well advanced to plant a forty acre trial on each Host Estate with five of the best dura progenies from each of the four Host Estates (i.e. a total of 20 progenies in each trial). It is appreciated that five progenies are rather few to represent each genetic stock but they may be sufficient to reveal any major differences.

As a corollary to this forty acre trial, it is planned that two estates, which have inbred lines of Deli dura, will collaborate in planting an experiment designed to test various degrees of inbreeding and outbreeding according to aim (iii).

Breeding the Tenera Palm

Normal tenera:

There are only three fertile pisifera palms at Serdang but it was decided that no infertile palms should be used as they could not be identified for certain as pisifera. These three fertile pisiferas were each to be tested in a series of ten tenera progenies. The progenies were to be made according to a system which would also help to elucidate the characteristics of the best type of dura palm for use in tenera seed production.

The programme was only partly successful. One of the pisiferas (27B) produced no more male flowers soon after crossing began and systematic use of so few mother dura palms gave inadequate seed to compensate for poor germination. The nineteen progenies which have reached the nursery and field stage (Table XVI) should, however, give some very useful information.

The proposed comparison of Host Estate dura breeding stocks has been mentioned. In addition to this, the same stocks are to be tested in tenera progenies produced in most cases by the use of standard pisifera pollen supplied by the Department. The pisifera pollen was mainly collected from two Serdang palms but small quantities imported from Cowan Estate, Nigeria, have also been distributed.

The various types of tenera material to be tested on Host Estates therefore fall into four main groups:

Dura origin	*Pisifera origin*
Serdang	Serdang
Host Estates	Department of Agriculture (ex Nigeria)
Host Estates	Host Estates (ex foreign source)
Host Estates	Serdang

Dumpy tenera:

Some yield records from Dumpy-teneras have already been commented upon but it is much too early to estimate the value of this material. These Dumpy-teneras at five years of age appear to have a girth which is certainly no larger than that of the (Dumpy x Tall) dura hybrids and it is evident that the anticipated long series of back-crossed and selfed generations will have to be accepted if pisifera and tenera palms with the true 'Dumpy' habit are to be grown.

Unfortunately the only strain of 'short' pisifera palms known at the moment, and which might have proved a useful alternative to a Dumpy pisifera, is growing in West Africa (progeny of 16R at INEAC). Pollen from this source was obtained in 1954 but the tenera seeds harvested were shared with an estate and INEAC, so that only 16 seedlings were eventually planted in the field by the Department. Attempts are still being made to obtain more pollen from INEAC.

With this exception, the experiments planted with Dumpy dura and tenera palms are now thought to be adequate, and additional progenies of this type have been included in recent trials only for purposes of comparison.

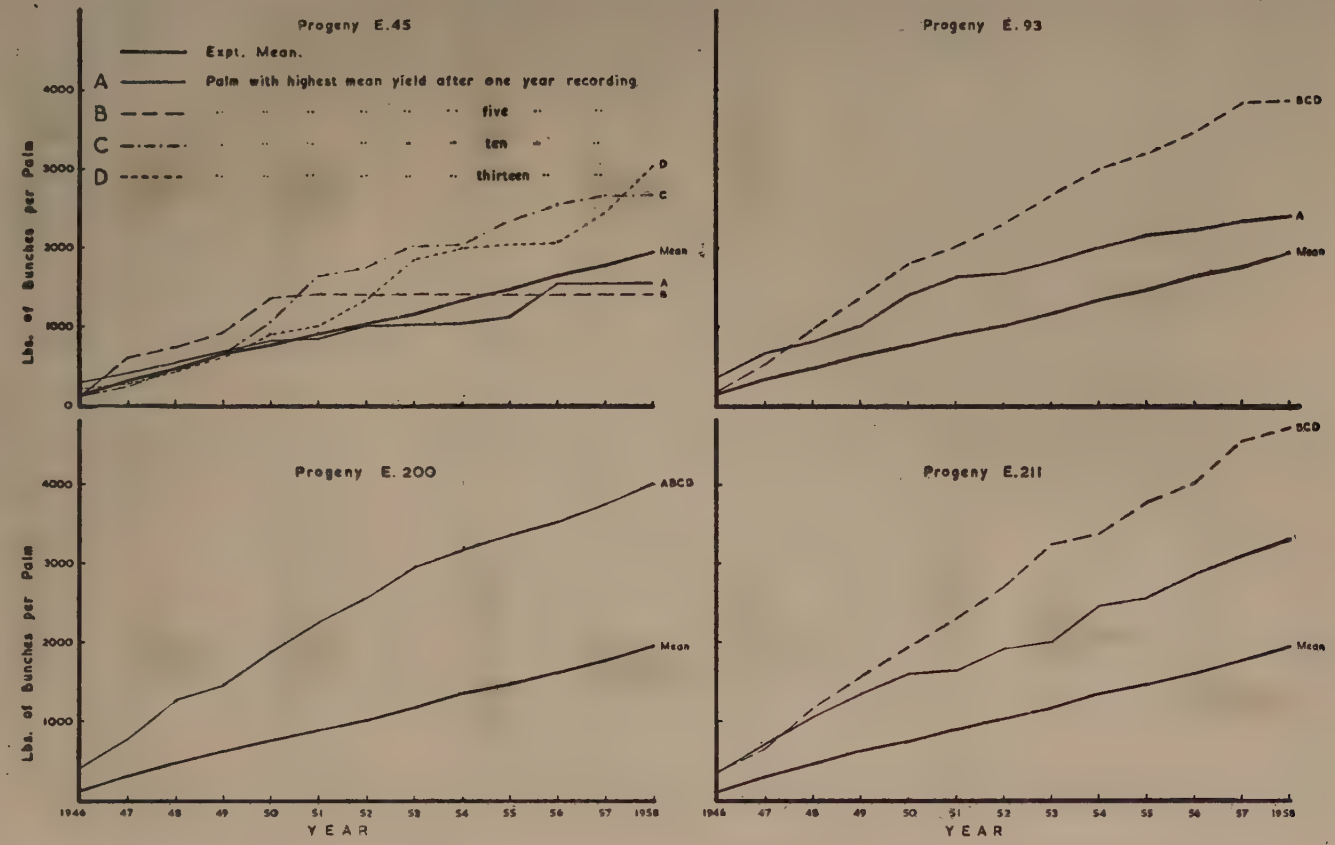
Breeding the Pisifera Palm

It is conceivable that fertile pisifera palms might eventually be planted over a large acreage as a commercial crop but in the meantime the improvement of pisifera palms is regarded as complementary with tenera breeding.

The Serdang population of three fertile pisifera palms was a ridiculously small number to rely upon as a basis for a tenera breeding

FIG. 5

Selection of Deli Dura Palms at F.E.S. Seradang (Expt. 0.1) —Accumulative Yield of Bunches.


Progeny E.45
Expt. Mean.
A Palm with highest mean yield after one year recording
B .. .. five .. ..
C .. .. ten .. ..
D .. .. thirteen .. ..
Lbs. of Bunches per Palm
Mean
Progeny E. 93
BCD
A
Mean
Progeny E. 200
ABCD
Mean
Progeny E.211
BCD
Mean
1946 47 48 49 50 51 52 53 54 55 56 57 1958
YEAR

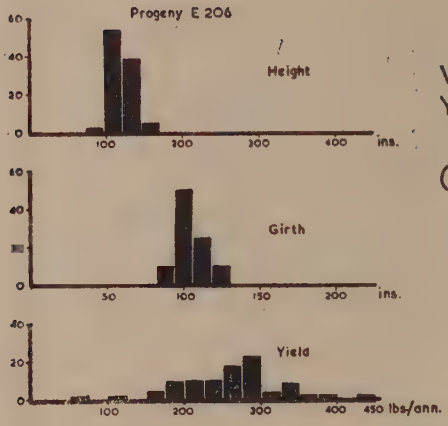
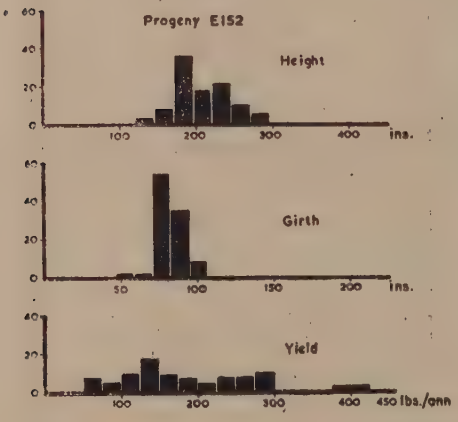
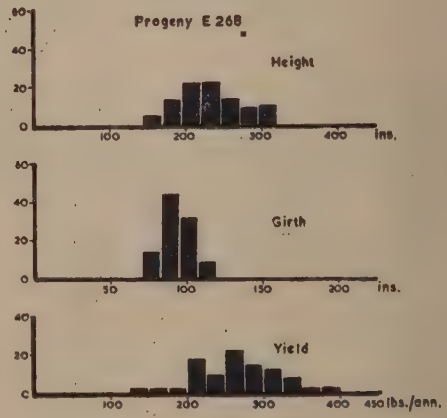


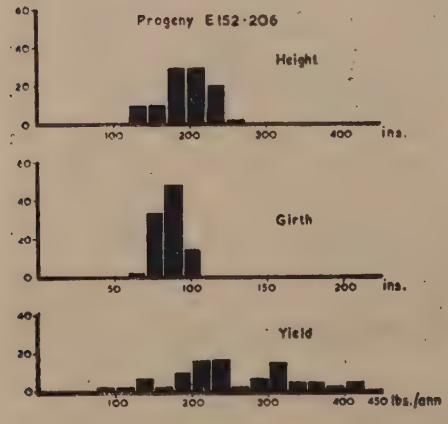
Fig 6

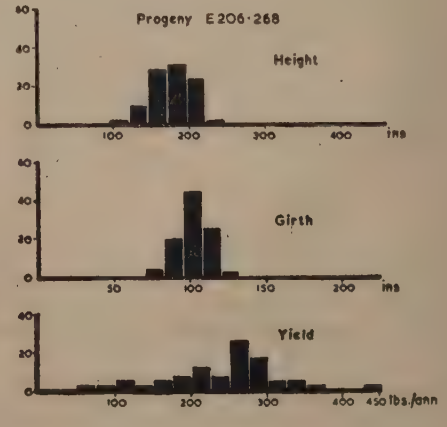
Variability Of Height, Girth & Yield In Deli Dura Palms At F.E.S. Serdang.

(as a percentage of not less than 40 palms per progeny)









programme and so, as early as 1950, 790 TT seeds were imported from W.A.I.F.O.R. (Nigeria). These were followed, in 1954, by a supply of 1,200 TT seeds and 5,200 PP kernels from I.R.H.O.† (French West Africa).

Eighty five seedlings were grown from the W.A.I.F.O.R. TT seed and these were all planted at F.E.S., Jerangau, where not one has been identified as pisifera. The I.R.H.O. seed did not germinate well and only seven seedlings of the PP seed and 238 of the TT seed reached the field. No pisiferas have been positively identified in the TT area, one of the "PP" seedlings is definitely fertile pisifera and the other six bear fruit of the tenera type!

In order not to confine all the selection of pisiferas to fertile strains, and to admit the possibility of producing a useful female-sterile strain for tenera breeding, it is proposed to establish a trial in which the main comparison will be between tenera palms of fertile and infertile pisifera parentage. The pisifera pollen for this trial was imported from Cowan Estate in Nigeria, as there are no infertile palms in Malaya which have been positively identified as pisifera by progeny testing. The dura palms used as mother parents are growing on Host Estates and at Serdang, so the results of the trial should, so far as this source of pollen is concerned, be generally applicable.

Another supply of "infertile" pisifera pollen was obtained in 1956 from progeny tested palms in Sumatra and also a small quantity of TP seed derived from descendants of the fabulous A.V.R.O.S.* tenera "SP 540". Unfortunately, through poor seed germination the number of palms reaching the field in Malaya from this source will be low.

It is axiomatic that a Dumpy pisifera palm must precede the development of fully Dumpy tenera palms, and to speed up this work, some crosses among first generation Dumpy teneras, and backcrosses of them to Dumpy dura and normal pisifera, have been made well before the accumulation of the minimum data normally regarded as essential.

The Genetic Collection

Although there is no intention at the moment of exploiting the full intra-specific variability of *Elaeis guineensis*, it was considered that small comprehensive collection should be made on each Host Estate of as many different varieties and types as possible, so that an adequate foundation stock would be available if required.

Seedlings now in Host Estate nurseries originate from: a gift of *dura virescens* seed from Ulu Remis Estate; small quantities of *dura albescens* and *idolatrica* seed from W.A.I.F.O.R. and some *dura mantled* and dura (*guineensis* x *melanococca*) hybrid seedlings from Serdang. Further supplies from West Africa are awaited.

† I.R.H.O. = Institut De Recherches Pour Les Huiles et Oleagineux.

* A.V.R.O.S. = Algemeng Vereniging van Rubber Planters Ter Oostkust van Sumatra.

Discussion

At Serdang, the best Elmina dura progenies have now given more than twice the total crop harvested from the poorest progenies and this superiority shows no indication of becoming less with age. (Figs 1A & 1B). Similar large differences in progeny performance are found in young palms of the next generation and the potentialities of improving the Deli dura palm by selection alone are far from exhausted.

Dumpy dura palms have failed to come up to expectations, and with a rapidly rising standard of planting material, which tends to reduce the economic life of a palm, and the widespread use of the pole and sickle for harvesting, the importance of a slow growing palm has diminished. However, the tendency to favour early maturing, fast growing strains could easily go too far and the development of a high yielding Dumpy dura or tenera must continue as a long term project.

The genetics of Dumpiness remains rather obscure because the early trials of Dumpy and semi-Dumpy palms were intended to test yield and not growth habit. However, it is quite clear that both stem height and girth are under the control of quantitative genetic factors, and that those for greater height and girth tend to be dominant. The exceptional uniformity in height and girth of the Dumpy palms at Serdang is illustrated in Fig. 6, and the expected segregation within Dumpy-backcross and semi-Dumpy sib progenies can be seen from Fig. 3. As mentioned earlier, the absence, from the semi-Dumpy sib progeny, of even one palm with either a short trunk and/or a large girth is rather surprising although it may be due to the small population of only 35 palms.

The short stem height of Malayan tenera palms (Table XVII and Fig. 4) indicates that little or no hybrid vigour has been obtained by crossing the inbred Deli dura palm with the West African pisifera. On the other hand, the good bunch quality of the teneras indicates that their fertility has not been affected by this outbreeding.

There is no really satisfactory explanation of how the same lot of West African pisifera pollen, represented by progenies in trials 0.18 and 0.20, should have failed to have given rise to teneras in one case and succeeded in the other. Poor pollination and experiment technique are, of course, possibly responsible for this anomaly and no doubt this explanation is even more likely to apply in the case of the teneras grown from "PP" seed. As a working hypothesis the theory advanced by Beirnaert and Wanderweyen must be accepted and the authors are content to await the outcome of trials comparing tenera palms descended from fertile and infertile pisiferas before entering into further speculation on the inheritance of shell thickness.

Tenera palms are, in fact, now being planted extensively in Malaya and since they are all of known pedigree origin it is possible that a healthy demand will eventually arise for tenera seed descended from certain proven pisiferas. If this demand extends to the dura mother palm as well, so much the better. The industry would do well to eliminate one hazard from the many it has to contend with.

Summary

It is the authors' intention to show how the present programme of oil palm selection and breeding has developed out of past experience. Some of the data is presented on which progenies and individual palms were selected and particular mention is made of the Dumpy dura palm and its failure as a commercial strain. The development of the "Co-operative Breeding Scheme" and the coincident rise in popularity of the tenera palm have largely governed the direction of the work now being undertaken.

Some trends in Malayan oil palm breeding are discussed, and attention is drawn to the potential value of "proven" seed.

Acknowledgements

Among the many members of the Department who have, over the last thirty years, taken part in work mentioned in this article, the contributions by Jagoe, later assisted by Rosenquist, are outstanding.

No less important is the generous assistance given by the management of estates and agencies and this is recorded with sincere gratitude.

Much of the tedious field recording has been done under arduous conditions, and to those who had been engaged in this way for many years the authors feel particularly indebted.

References

(1) Jagoe, R.B. (1952): "Deli Oil Palms and early introductions of *E. Guineensis* to Malaya." *Malay. agric. J.*, **35**.

(2) Jagoe, R.B. (1952): "The Dumpy oil palm." *Malay. agric. J.*, **35.**

(3) Toovey, F.W. and Brockmans, A.F.M. (1955): "The Deli dura palm in West Africa." *J.W. Afric Inst. Oil Palm Res.*, Vol. I, No. 3.

(4) Beirnaert, A. and Wanderweyen, R. (1941): "Contribution a la etude genetique et biometrique des varietes d'Elaeis Quineensis." I.N.E.A.C. Serie Scientifique, No. 27.

(5) Haines, W.B. (1959): "The significance of Cyclic Peak Yields in Nigerian Oil Palms." *Empire J. Expa. Agric.*, Vol. XXVII, No. 105.

(6) Vanderweyen, R., Rossignol, J., Miclotte, H. (1947): "Considerations sur les teneurs en eau et en huile de la pulpe des fruits d' Elaeis." *C.R. de la Semaine Agricule de Yongambi*, Commn. No. 54.

(7) Chapas, L.C., Tinker, P.B.H., Ziboh, C.O. (1957): "The determination of the oil content of oil palm fruit." *J.W. Afric. Inst. Oil Palm Res.*, Vol. II, No. 7.

(8) Brockmans, A.F.M. (1956): "Factors influencing the periodicity of growth and flowering in the oil palm." Paper presented to the Franco-British Conference on Oil Palms.

(9) Coulter, J.K. and Rosenquist, E.A. (1955): "Mineral nutrition of the oil palm". *Malay. agric. J.*, **38**, 4.

(10) Pronk, F. (1956): "Vergelijkend tros-analystisch onderzoek van enkele typen van de oliepalm." *De Bergcultures*, V. 25, No. 4.

(11) Vanderweyen, R. (1952): "Notions de culture de l'Elaeis au Congo Belge." Bruxelles.

(12) Hartley, C.W.S. (1958): "Advances in oil palm research in Nigeria in the last twenty five years". *Empire J. Expt. Agric.*, Vol. XXVI, No. 102.

PLATE I

Dumpy dura palm (F_2) at Ulu Bernam Estate
(Expt. 0.5, age 7½ years)

PLATE II

Hybrid (Dumpy dura x melanococca) seedlings in nursery at Jendarata Host Estate.
(Progeny 693, age 10 months)

PLATE III

PLATE IV

Dumpy dura palms at Highlands Estate.
Expt. 0.16, age 3 7/12 years (Plate III) and 6 8/12 years (Plate IV).

PLATE V

PLATE VI

Dumpy back-cross dura palms at Highlands Estate.
Expt. 0.4, age 5 years (Plate V) and 8 years (Plate VI).
Note the broad leaf bases which are a hindrance to harvesters.

PLATE VII

Dumpy palms frequently produce a frond with a fore-shortened tip (right). Normal Dumpy frond tip shown at left.

PLATE VIII

Spikes dissected from young fruit bunches of normal Deli dura palm (left) and Dumpy Deli palm (right). The poor ratio of fruit-to-bunch for ripe Dumpy palm bunches may be due to the malformed spike tip preventing pollen from reaching the inner flowers.

Table I

Oil Palm Genetic Material Imported by the Department of Agriculture, 1946-58.

POLLEN

Place of Origin	Genetic Origin	Date received	Corresponding number of palms in the field
Nigeria (W.A.I.F.O.R.)	Mixed pisiferas	November, 1950 to March, 1951	536 (D.P.)
	One fertile pisifera	July, 1952	365 (D.P.)
Nigeria (Cowan Estate)	Nine infertile pisiferas	April to June, 1958	Not yet planted
	Six fertile pisiferas	April, May, 1958	" " "
Sumatra (A.V.R.O.S.)	One fertile pisifera	April, 1956	" " "
	One infertile pisifera	February, 1957	" " "
	One mantled pisifera	April, 1956	" " "
Sumatra (Gunong Melaju Estate)	Two short-trunked Deli dura	April, 1956	283 (D.D.) to date
French West Africa (I.R.H.O.)	Nine fertile pisiferas	January, 1953 to Sept., 1954	848 (D.P.)
Belgian Congo (I.N.E.A.C.)	Mixed pisiferas	October, 1953	23 (D.P.)
	Pisifera 16R. 16R.	May, 1954	16 (D.P.)

SEED

Place of Origin	Genetic Origin	Date received	No. received	Corresponding number of palms in the field
Nigeria (W.A.I.F.O.R.)	D.P. "extension mixture"	November, 1950	190	Failed to germinate
	One tenera (selfed)	November, 1950	790	85
	One albescens dura progeny	June, 1958	750	Not yet planted
	One idolatrica dura progeny	December, 1958	300	Not yet planted
French West Africa (I.R.H.O.)	13 P.P. progenies of fertile pisiferas	October, 1953 to July, 1954	5,200	7
	3 T.T. progenies	February, 1954 to May, 1954	1,200	238
French West Africa (Brazzaville)	One melanococca progeny	March, 1951	200	1
Sumatra (A.V.R.O.S.)	One T.P. progeny	February, 1957	500	Not yet planted
	One D.D. progeny	February, 1957	600	Not yet planted
Sumatra (B.O.C.M.)	One D.P. progeny	September, 1953	1,000	60
Sumatra (Gunong Melaju Estate)	3 D.D. progenies from short-trunked palms	February, 1957	2,030	673, to date

Table II

Elmina Selfed Dura Lines

Experiment 0.1

Variety	F.F.B. (tons/acre/ann.)	Bunch No. (acre/ann.)	Mean Bunch Weight (lb.)	Fruit to Bunch Ratio (%)	Mesocarp to Fruit Ratio (%)
E. 45	3.0	226	29.7	58	58
E. 93	3.4	255	25.3	63	68
E.200	3.7	204	39.7	65	62
E.211	5.2	341	33.9	62	61
S.E. (12)	± 0.9	± 12	± 0.8	± 2	± 1

Locality: Federal Experiment Station, Serdang. Date planted: 1937
Planting Distance: 30 x 30 ft. (triangular). Palms per plot: 1 x 11
Design: Randomised Block, 5 Replications.
Period covered by data in table: F.F.B, Bunch No. and Wt., 1946 to 1958.
Fruit and mesocarp ratios 1947 to 1950.

Experiment 0.2

Variety	F.F.B. (tons/acre/ann.)	Bunch No. (acre/ann.)	Mean Bunch Weight (lb.)	Fruit to Bunch Ratio (%)	Mesocarp to Fruit Ratio (%)
E. 97	3.3	372	20.1	60	61
E.152	3.4	257	29.8	60	68
E.207	3.7	222	37.2	63	61
E.216	4.6	352	30.7	58	64
E.268	5.6	356	35.2	58	65
S.E. (20)	± 0.5	± 18	± 1	± 1	± 1

This trial was planted in 1939 and has six replicates. Other experiment details are the same as for 0.1.

Elmina Dura Lines Under Observation

Variety	F.F.B. (tons/acre/ann.)	Bunch No. (acre/ann.)	Mean Bunch Weight (lb.)	Fruit to Bunch Ratio (%)	Mesocarp to Fruit Ratio (%)
FIELD 3A					
E.206 (Dumpy)	5.9	330	40	56.2	64.4
E.152.206 (semi-Dumpy)	5.7	314	41	67.8	62.3
E.206.268 (semi-Dumpy)	5.4	286	42	55.5	64.7
FIELD 4.					
E.268 (Normal)	4.7	319	29	58.9	63.1
E.366 („)	5.1	336	34	60.4	60.3
E.120 („)	6.1	385	35	59.7	63.5
E.206 (Dumpy)	3.2	248	29	57.9	61.7

These palms were planted in unreplicated blocks in field 4 in 1939 and in field 3A in 1940. Other details are the same as for palms in trial 0.1.

Table III

"Avenue" Progenies at F.E.S., Serdang

Group	Yield of F.F.B. (tons/acre/ann. 1937-1940)	
	Selected progenies (Means of four)	Unselected controls (Means of two)
I	5.2	5.4
II	4.1	4.1
III	4.2	4.1
IV	4.2	4.1
V	3.2	3.8
VI	1.5	3.1
VII	1.2	1.7
VIII	0.7	1.3
IX	0.4	1.4
X	0.4	1.0

Locality: Field 10A, F.E.S., Serdang. Date planted: 1930

Planting distance: 30 x 30 ft., triangular.

Palms per plot: Single row of 31 to 39 palms per progeny.

Design: Unreplicated single rows of 40 different control pollinated progenies from selected Avenue palms, interplanted every fifth row with a control of open pollinated seed from the Avenue.

(Progeny 19 x 65, which yielded so well at W.A.I.F.O.R., is not represented in this trial).

Table IV

Dumpy Dura Progeny Trials

Experiment 0.7

Dumpy Variety	F.F.B. (tons/acre) 1958	Bunches/Acre 1958	Mean Bunch Weight (lb.)
2.3 selfed	5.0	474	24
2.4 „	4.8	521	21
2.3 x 2.4	5.8	526	25
1.9 x 2.4	5.1	517	22
1.4 x 2.4	5.1	572	20
3.5 x 2.4	5.4	610	20
2.3 x 3.5	5.4	573	21
1.9 x 3.5	5.4	594	20
1.10 x 3.5	3.9	521	17
3.8 x 3.5	4.8	621	17
1.9 x 3.7	4.8	495	22
2.4 x 3.7	4.7	545	19
3.9 x 3.7	4.2	532	18
2.9 x 55.8	4.7	618	17
3.6 x 55.8	3.6	510	15
1.4 x 1.9	5.8	610	21
S.E. (60)	± 0.3	± 32	± 0.8

Locality: Estate H., Selangor. Date planted: October, 1952.
Planting distance: 30 x 30 ft., triangular. Palms per plot: 18 (6 x 3)
Design: Symmetrical Incomplete Block (k = 4, b = 20 and r = 5)

Experiment 0.16

Dumpy Variety	F.F.B. (tons/acre) 1958	Bunches/Acre 1958	Mean Bunch Weight (lb.)
2.4 selfed	3.4	394	19
2.3 x 2.4	4.1	390	22
52.6 x 2.4	3.3	488	15
1.5 x 2.4	4.2	453	21
1.9 x 2.4	4.0	447	20
1.9 x 3.5	4.2	513	18
2.3 x 3.5	4.8	532	21
1.1 x 3.5	3.4	526	14
1.1 x 55.8	2.4	365	15
1.1 x 3.7	1.8	292	14
1.1 x 1.7	3.6	458	17
4.6 x 1.7	3.7	462	17
S.E. (44)	± 0.3	± 47	± 0.6

Locality: Estate H., Selangor. Date planted: October, 1952.
Planting distance: 30 x 30 ft., triangular. Palms per plot: 12 (4 x 3)
Design: Randomised Block, 5 Replications.

Table V

Dumpy Dura Progeny Trial
Experiment 0.5

Variety	F.F.B. (tons/acre)				Mean No. of bunches per acre			Mean Bunch Weight (lb.)		
	1956	1957	1958	Mean	1956	1957	1958	1956	1957	1958
1.7 x 3.5	3.1	4.6	5.7	4.3	480	364	593	14	26	22
3.5 x 1.7	3.0	4.5	6.3	4.7	474	389	655	14	25	22
2.4 x 1.7	3.2	5.3	6.4	4.5	473	396	770	15	26	21
3.5 x 2.4	3.3	4.8	5.4	4.4	506	399	606	15	24	20
3.4 x 2.4	3.1	4.6	5.7	4.3	473	386	602	15	24	21
S.E.(18)	±0.6	±01	±1.2	±0.2	± 32	± 15	± 93	± 1	± 1	± 1

Locality: Estate U.B., Perak.
Planting distance: 32½ x 32½ ft. (triangular)
Date planted: November, 1951.
Palms per plot: 1 x 14
Progenies (1.7 x 3.5) and (2.4 x 1.7) are dupliated.
Design: Randomised Block, 4 Replications.

Table VI

Dumpy Back-cross Dura Progeny Trial
Experiment 0.6

Variety	F.F.B. (tons/acre)				No. of bunches per acre			Mean Bunch Weight (lb.)		
	1956	1957	1958	Mean	1956	1957	1958	1956	1957	1958
Semi-Dumpy x Dumpy										
4.8 x 1.1	3.1	4.3	5.4	4.3	528	423	558	13	22	22
5.5 x 1.1	3.1	3.8	4.9	3.9	543	466	589	13	17	18
5.5 x 55.8	3.1	3.7	5.2	4.0	512	370	553	14	21	21
5.5 x 1.7	2.8	3.4	4.8	3.7	492	361	530	13	19	20
7.6 x 1.7	3.3	4.5	6.8	4.9	567	453	626	13	21	24
14.2 x 1.7	3.2	4.9	7.1	5.1	457	367	543	16	28	29
6.2 x 3.7	3.0	4.1	6.3	4.5	479	417	548	14	21	22
S.E.(18)	±0.2	±0.3	±0.3	±0.4	± 27	± 29	± 30	± 1	± 1	± 1

Experiment details are the same as those for 0.5 (Table V).

Table VII

Dumpy Back-cross Dura Collection
Experiment 0.4

Variety	No. of Palms	F.F.B. (tons/acre)				No. of bunches per acre			Mean Bunch Weight (lb.)		
		1956	1957	1958	Mean	1956	1957	1958	1956	1957	1958
Semi-Dumpy x Dumpy											
12.3 x 1.7	237	9.9	10.9	10.2	10.2	1101	872	780	20	27	30
14.2 x 1.7	296	8.7	10.3	10.7	9.9	978	769	783	20	31	31
12.3 x 1.1	103	8.9	9.4	8.9	9.1	1159	939	798	17	22	25
14.2 x 1.1	35	7.7	10.5	9.4	9.2	941	680	764	18	35	27
12.3 x 3.5	139	8.6	9.7	9.7	9.3	1076	918	851	18	24	26
14.2 x 3.5	105	7.6	10.1	9.3	9.0	947	922	827	18	24	25
Semi-Dumpy sib.											
14.2 x 10.8	35	8.7	8.7	8.0	8.5	964	743	653	20	26	28

Locality: Estate H., Selangor.
Planting distance: 40 x 20 ft. square.
Date planted: May, 1951.
Palms per plot: Variable, but in adjacent rows of approx. 35 palms each.
Design: Unreplicated Blocks.

Table VIII

Comparative Yields from Young Dumpy Dura Palms and Dura Palms of Normal Commercial Origin

Estate	Dumpy Palms		Estate Palms	
	Age (Years)	F.F.B. (tons/acre/ann.)	Age (Years)	F.F.B. (tons/acre/ann.)
I (Selangor)	6	2.4	6	9.2
II (Selangor)	6	4.2	7	9.3
III (Selangor)	6	4.1	10	7.5
IV (Selangor)	6	4.5	6	6.8
V (Perak)	7	5.9	7	6.6
VI (Johore)	6	2.7	6	6.7
VII (Johore)	6	3.1	6	6.5

Table IX

Dumpy Dura versus Estate Dura Palms

Experiment 0.24

Variety	Pedigree	F.F.B. (tons/acre/ann.) 1958	Bunches/acre 1958	Mean Bunch Weight (lb.)
Estate	298 x E.117/1	4.8	653	16.5
Dumpy	1.9 x 3.5	2.1	258	18.3
„	3.5 x 2.4	1.6	198	18.2
„	1.9 x 2.4	1.6	216	16.6
„	2.4 x 2.4	1.9	248	17.2

Locality: U.R. Estate, Johore. Date planted: October, 1952.
Planting distance: 33 x 33 ft., triangular 46 palms/acre. Palms per plot: 12 (4 x 3)
Design: Randomised Block, 4 Replications. (One row of points not planted between estate and Dumpy plots to reduce competition).

Table X

Dumpy Dura versus Normal Elmina Dura

Experiment 0.17

Variety	F.F.B. (tons/acre)	Bunch No.	Mean Bunch Weight (lb.)	Height increment (in./ann.)	Girth (in.)
Dumpy dura	2.6	340	17	20	127
Tall dura	3.8	474	18	29	114
S.E. (3)	± 0.3	± 11	± 0.8	± 1.4	± 1.3

Locality: Estate C., Selangor. Date planted: March, 1953.
Planting distance: 31½ x 31½ ft. (triangular). Palms per plot: 1 x 21
Design: Randomised Block, 4 Replications.
Period covered by data in table: Yield, May, 1958 to March, 1959. Growth, April, 1959.
(Height measured from ground to lowest bunch. Girth at 18 in. from ground).

Table XI

Deli Dura Progeny Trial

Experiment 0.8

Origin	Variety	F.F.B. (tons/acre) 1956	1957	1958	Mean	No. of bunches per acre 1956	1957	1958	Mean Bunch Weight (lb.) 1956	1957	1958
Estate X	1140 x 1139	3.9	5.9	6.9	5.6	797	714	776	11	19	20
	1140 selfed	4.4	6.0	7.4	5.9	932	719	858	11	19	20
Estate Y	220/4 x 261	4.1	7.0	8.1	6.4	833	947	1078	11	16	17
	174/12 x E.63/17	5.3	7.6	7.7	6.9	1052	1097	1109	11	16	15
Serdang	(a) 47.2 x 25.5	4.5	7.0	8.4	6.6	670	833	917	14	19	21
	(b) 14.2 x 10.8	4.1	7.5	8.1	6.6	605	728	756	15	23	24
S.E. (15)		± 0.4	± 0.5	± 0.5	± 0.4	± 62	± 49	± 54	± 0.5	± 0.7	± 0.6

Locality: F.E.S., Jerangau.
Planting distance: 30 x 30 ft. (triangular)
Design: Randomised Block. Replications 4.
(a) = Normal Elmina dura.

Date planted: November, 1952.
Palms per plot: 16. (4 x 4)

(b) = Semi-Dumpy sib.

Table XII

Dura and 'Tenera' Progeny Trial

Experiment 0.18

Origin	Variety	Pedigree	F.F.B (tons/acre) 1957	1958	Mean No of bunches per acre 1957	1958	Mean Bunch Weight (lb.) 1957	1958
Estate Y	Dura	229/1 x 168/1	2.4	6.5	553	1036	10	15
	Dura	183/1 x 279/1	2.1	4.9	493	1009	10	11
Serdang	'Tenera'	41/1 x Nigerian pisifera	2.5	6.9	594	820	10	19
	'Tenera'	4/9 x Nigerian pisifera	2.3	4.3	612	587	9	17
S.E. (9)			± 0.3	± 0.5	± 56	± 62	± 1	± 1

Locality: F.E.S.. Jerangau.
Planting distance: 32 x 32 ft. (triangular).
Design: Radomised Block. Replications 3.

Date planted: December, 1953.
Palms per plot: 12. (4 x 3).

(All of the supposedly 'tenera' palms have produced fruit with a dura type of shell).

Table XIII

Dumpy Tenera and Dumpy Backcross Progeny Trial
Experiment 0.19

Variety	Percentage Tenera Palms	F.F.B. (tons/acre) 1957	F.F.B. (tons/acre) 1958	No. of bunches per acre 1957	No. of bunches per acre 1958	Mean Bunch Weight (lb.) 1957	Mean Bunch Weight (lb.) 1958
DUMPY TENERA							
2.4 x Nigerian pisifera	87	4.9	8.0	796	855	14	21
1.7 x Serdang pisifera 27B	75	4.5	6.9	724	790	14	20
3.5 x Serdang pisifera 27B	91	5.0	8.4	870	962	13	20
DUMPY BACKCROSS DURA							
12.3 x 3.5	0	4.4	6.9	791	808	12	19
12.3 x 1.9	0	2.3	5.2	504	737	10	16
12.3 x 1.7	0	3.6	6.7	702	859	11	18
S.E. (20)		± 0.3	± 0.5	± 43	± 54	± 1	± 1

Locality: F.E.S., Jerangau.
Planting distance: 32 x 32 ft. (triangular)
Design: Randomised Block. Split plot.

Date planted: December, 1953.
Plants per plot: 12. (4 x 3).
Replications 5.

Table XIV

Dumpy Tenera Collection
Experiment 0.20

Variety	No. of Palms	Percentage Tenera Palms	F.F.B. (tons/acre) 1957	F.F.B. (tons/acre) 1958	Mean No. of Bunches per acre 1957	Mean No. of Bunches per acre 1958	Mean Bunch Weight (lb.) 1957	Mean Bunch Weight (lb.) 1958
DUMPY TENERA								
2.4 x Nigerian pisifera	10	70	2.5	6.1	490	765	11.4	17.9
3.5 x Nigerian pisifera	10	0	1.0	4.2	237	770	9.2	12.1
1.9 x Nigerian pisifera 11000	22	0	1.0	2.8	259	390	8.5	16.2
3.5 x Serdang pisifera 27B	10	90	0.6	5.9	193	968	7.1	13.7
55.8 x Serdang pisifera 27B	10	80	2.1	5.7	424	759	11.4	16.9
1.7 x Serdang pisifera 27B	10	70	1.4	5.8	314	754	9.9	17.3

Locality: F.E.S., Serdang.
Planting distance: 30 x 30 ft. (triangular).
Design: Unreplicated Blocks.

Date planted: December, 1953.
Palms per plot: (see table).

Table XV

"Dumpy x Short" and Similar Dura Progenies for Trial on Host Estates

Type of Progeny	No. of different progenies on Host Estates (> 60 palms/site)				
	Klanang Bahru	Ulu Remis	Johore Labis	Jenda-rata	Total
Dumpy x Tumbuk Estate near-Dumpy	5	6	7	4	9
Dumpy x Johore Labis short palm 4001	2	1	2	2	2
Dumpy x Ulu Remis short palms	3	2	2	3	3
Dumpy x Gunong Melaju Semi-short palms	2	1	2	1	2
Dumpy x semi-Dumpy	5	2	2	2	5
Dumpy x Normal dura	2	2	2	2	4
Dumpy "selfs"	5	5	5	5	5
Other short palms	2	2	2	1	2
Other short "selfs"	1	1	1	1	1
Dumpy dura controls	4	5	5	6	6

Table XVI

Progenies for Testing Serdang Pisifera Palms

Pisifera Identity	No. of different tenera progenies on Host Estates				
	Klanang Bahru	Ulu Remis	Johore Labis	Jenda-rata	Total
27B	5	4	4	3	6
29.36	8	5	5	5	9
36.21	2	3	2	3	4

Table XVII

Height-Girth Relationship of Various Dumpy, Semi-Dumpy and Normal Palms

Expt. Number	Location	Variety	Age of palms (years)	Height increment (in./annum)	Girth (in.)	
	Elmina Estate	Normal dura	15	12.5	89	
	Elmina Estate	Dumpy dura, Po	15	8.8	113	
0.2	F.E.S. Serdang	Normal dura (E. 268)	13	14.4	93	
0.2	F.E.S. Serdang	Normal dura (E. 152)	13	12.6	81	
0.3	F.E.S. Serdang	Dumpy dura F_1 (E. 206)	12	9.5	107	
0.3	F.E.S. Serdang	Semi-Dumpy dura (E. 206.268)	12	13.5	87	
0.3	F.E.S. Serdang	Semi-Dumpy dura (E. 152.206)	12	13.4	98	
0.5	Estate U.B.	Dumpy dura F_2 sibs.	7	6.4	141	(at 3 ft.)
0.6	Estate U.B.	Dumpy backcross dura	7	6.5	121	(at 3 ft.)
0.4	Estate H.	Dumpy backcross dura	8	11.9	119	
0.4	Estate H.	Semi-Dumpy dura F_2 sibs.	8	12.8	105	
0.4	Estate H.	Normal estate dura	8	14.4	101	
0.19	F.E.S. Jerangau	Dumpy backcross dura	5	10.0	105	(at 3 ft.)
0.8	F.E.S. Jerangau	Semi-Dumpy dura F_2 sibs.	6	12.7	102	
0.8	F.E.S. Jerangau	Normal Serdang dura	6	14.5	105	
0.19	F.E.S. Jerangau	Dumpy tenera	5	9.0	101	(at 3 ft.)
0.18	F.E.S. Jerangau	Normal tenera	5	9.2	104	(at 3 ft.)
0.17*	Estate C	Dumpy dura F_2 sibs.	6	3.3	127	(at 1.5 ft).
0.17*	Estate C	Normal dura	6	4.8	114	(at 1.5 ft.)

* The abnormally small height increment of palms in experiment 0.17 can be attributed to flood and beetle damage.

Girth measurements were taken 4 ft. above ground, over the butts, except where stated otherwise.

VISUAL SYMPTOMS OF MAJOR NUTRIENT DEFICIENCIES OF THE SINGAPORE SPANISH PINEAPPLE

BY

K. KANAPATHY,

Soil Chemist.

Introduction

One of the methods used to diagnose mineral deficiencies of plants is by the recognition of visual symptoms. The method has its advantage in speed and that it does not require any apparatus; but, like other methods, it has many disadvantages. Symptoms of one deficiency may be complicated by some other deficiency or suppressed by factors like climate, pests or disease. Again, symptoms may not be visible until the deficiency is acute and considerable damage has been done.

In order to isolate symptoms it is usual to grow plants in water or sand culture with pure chemicals. Deficiencies of the individual nutrient elements are created in the nutrient medium by omitting each element separately from the complete nutrient solution and the symptoms for each deficiency produced in this way are recorded.

Experimental

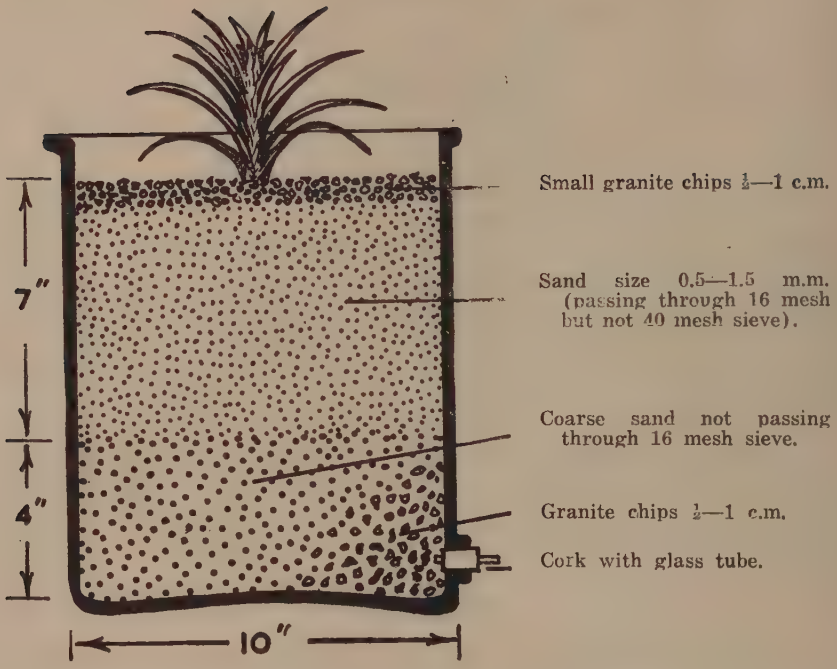
Glazed earthenware pots one foot high and ten inches in diameter were used for the sand culture experiment to produce deficiency symptoms. River sand was sieved and separated into three grades using sieves of 16 and 40 mesh. The particles passing through the 40 mesh sieve were rejected and the remaining two fractions were washed separately with dilute hydrochloric acid and then with water. The glazed earthenware pots were filled with the acid washed sand as shown in Figure I and slips of the Singapore Spanish pineapple were planted. The pots were kept in the open and rain water was not excluded. The experiment was done in duplicate and confirmed again in duplicate. The same symptoms were produced in all cases.

The complete nutrient solution, which produced good growth in the sand culture experiment and which was used to produce deficiency symptoms by withholding a nutrient, had the following composition:

Concentration in milligrams per litre

Nitrogen (N)	84-56	Manganese (Mn)	0.6
Phosphorus (P)	16.5	Copper (Cu)	0.2
Potassium (K)	100	Zinc (Zn)	1.0
Calcium (Ca)	94	Boron (B)	0.15
Magnesium (Mg)	32	Molybdenum (Mo)	0.18
Iron (Fe)	5.3		

FIG. I


Small granite chips ½—1 c.m.
Sand size 0.5—1.5 m.m. (passing through 16 mesh but not 40 mesh sieve).
Coarse sand not passing through 16 mesh sieve.
Granite chips ½—1 c.m.
Cork with glass tube.
7"
4"
10"

The following chemicals were used in the preparation of nutrient solutions.

For Major Elements:

$Ca(NO_3)_2\ 4H_2O$	$(NH_4)_2\ SO_4$
KH_2PO_4	$CaSO_4.2H_2O$
K_2SO_4	NH_4NO_3
$MgSO_4.7H_2O$	KNO_3

For Trace Elements:

$CuSO_4.5H_2O$	H_3BO_3
$ZnSO_4.7H_2O$	$(NH_4)_6Mo_7\ O_{24}.4H_2O$
$MnSO_4.4H_2O$	Ferric Citrate.

It seemed advisable to use 84 mg per litre of nitrogen for about six months and then change to 56 mg per litre, as the leaves appeared to be rather too green at the higher level from excessive nitrogen, which would result in poor quality fruit.

The nutrient solutions made with distilled water were added once daily until some of the solution dripped from the glass tube at the bottom. For one and a half months all plants were grown in the complete nutrient solution.

The pH of the solutions were made to 5.5 by the addition of dilute hydrochloric acid (1).

Visual Symptoms

Nitrogen Deficiency

The lack of nitrogen retarded growth and the plants were stunted. The leaves became narrow and developed a pale green colour. In the healthy Singapore Spanish pineapple plant the leaves are usually dark green with a reddish stripe along the edge which is not normally prominent but when nitrogen was deficient, these stripes became prominent and assumed a brownish red colour. When nitrogen deficiency became severe, the whole plant assumed a light greenish yellow colour and some of the leaves developed necrosis and died from the tips. (Plate I a, b).

Fruiting was delayed and the fruit produced was highly coloured, a combination of red and purple (Plate II). The fruits were small and deformed and no slips were formed at the base. The fruits were, however, sweet to the taste. No suckers were produced by the plants.

Phosphorus Deficiency

The effect of withholding phosphorus was not apparent for several months. It is possible that a considerable portion of the phosphorus required might have been taken up in the early stages of growth. Growth of the plants was therefore good but the leaves assumed a darker green colour which, although an indication of phosphorus deficiency, might be quite misleading. Phosphorus deficiency was characterised by the development of a purple colour on the mature leaves. (Plate I c.).

The fruits developed normally but were sour and watery.

Potassium Deficiency

The lack of potassium retarded the growth rate of the plants so that they became stunted. The leaves, starting from the more mature ones, developed a characteristic transparent pale yellow spotting. In the early stages these spots were not easily visible but when a portion of the leaf was examined from the underside, by holding it against a source of light or the blue sky, the spots became clear. When the deficiency became more serious, mottled yellow spots, sometimes slightly reddish, appeared on the leaves. The leaves, beginning from the more mature ones, started dying from their tips. (Plate I d.).

The fruits of potassium deficient plants were small. Many potassium deficient fruits have been analysed in connection with field experiments (2) and they have been found to have low sugar and acid content; that is, their quality was poor.

Calcium Deficiency

The growth of the plants was only slightly affected by withholding calcium. The leaves were softer, had a flatter appearance and were very dark green in colour. (Plate I, e).

The fruits were normal in appearance but tasteless.

MAGNESIUM DEFICIENCY

The growth of the plants was not affected but the leaves, especially the mature ones, turned a pale greenish yellow colour. Some of the older leaves turned completely yellow and the tips were scorched. (Plate I, f).

The size of the fruits was not affected but they were sour and lacked firmness.

Acknowledgements

The writer wishes to thank Mr. Philip de Souza for assisting in the preparation of solutions and for care of the plants, and Mr. Ng Beng Cheng for the illustrations.

References

(1) Hewitt, E.J. (1952): "Sand and Water Culture Methods used in the Study of Plant Nutrition", Tech. Comm. No. 22, Commonwealth Agricultural Bureaux.

(2) Kanapathy, K. (1958): "Leaf Analysis in Relation to Yield and Quality of Pineapples" *Malay. Agric. J.*, **41**, 1.

PLATE I

a b c d e f g

a — N Nitrogen deficiency, initial stages. Notice prominent margin of young leaf.

b — N Advanced nitrogen deficiency. Leaves are yellow and dying from the tips.

c — P Phosphorus deficiency. The leaves assume a purplish colour.

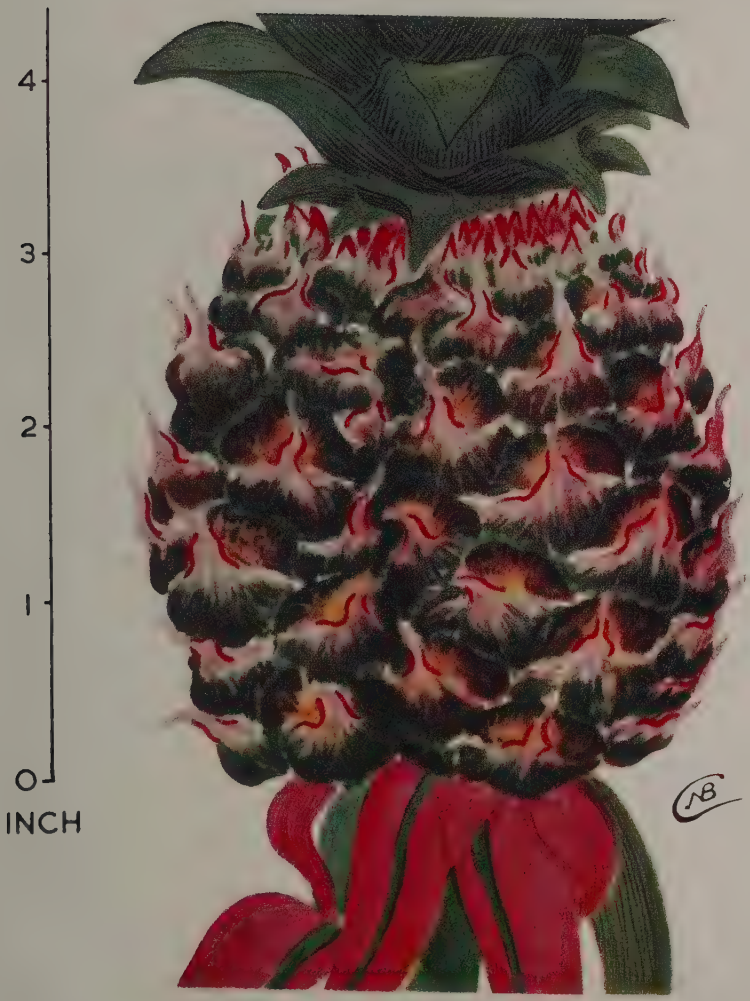
d — K Potassium deficiency. Leaves are spotted and begin to die from the tip.

e — Ca Calcium deficiency. Leaves are very dark green.

f — Mg Magnesium deficiency. The pale yellow colour develops first in the older leaves.

g — Control.

PLATE II



Fruit from a nitrogen deficient plant ready for harvesting. The fruit is highly coloured and very small. There are no slips at the base of the fruit.

NOTES ON CURRENT INVESTIGATIONS AND EXTENSION WORK

(July to September, 1959)

Weather

Weather conditions have been generally good for establishment of nurseries and transplanting of padi, with adequate water for irrigation. Shortage of water, however, has delayed transplanting in South Pahang and parts of Trengganu. Early indications are that there will be an above-average harvest.

Padi

Research

SARAWAK VARIETIES

Although the variety Engatek has now been released to farmers in Kedah and is undoubtedly a good one, its performance in variety trials in Malacca and Kedah has been rather poor. In Malacca (trials P 387 and 388) the standard variety, Siam 29, yielded more than any Sarawak variety during three years of trial and at Telok Chengai, Kedah, differences in yield after two years of trial (P. 426) were not significant.

SERAUP 50

Seraup 50 has now become one of the most popular and high yielding strains in Krian. Because its performance in variety trials was so good, it was released ahead of schedule and subsequent results have amply justified this action.

State	Area	Years of trial completed	% increase of S.50 over control S.K.48	Extra yield lb./acre
Perak	Kuala Kurau	3	37	998
„	Simpang Tiga	3	39	623
„	Titi Serong	3	28	644
„	Sungei Manik	3	18	310
„	Bruas	3	(—12)	(—187)
„	Bagan Serai	2	35	420
„	Selinsing	2	34	352
„	Talang	2	11	184
„	Briah	2	13	319
P.W.	Sg. Acheh	2	38	905
Penang	Genting	2	57	702

In all areas, except Bruas, Seraup 50 has yielded more than the standard control, Seraup Kechil 48, which if it were replaced by Seraup 50 entirely, would lead to an estimated total increase of 15,000 tons of milled rice per year.

SIAM

The first year's trial in Malacca of the second series of Siam selections indicated the best all-round strain from the first series (Sm. 48), compares favourably with strains in the second series both with regard to yield and lodging resistance.

PHOTOSENSITIVITY OF LOCAL PADI VARIETIES

Rice plants in the Kuala Lumpur padi cage tested under artificial lighting showed the expected response to varying light regimes. Only Pebifun, Radin Kling and a hybrid of Siam 29 crossed with Radin Kling were able to flower in a 13 hour day.

WATER REQUIREMENTS OF PADI

The soils/water station has been completed by the Drainage and Irrigation Department. The object of this station is to study the water requirements of padi. The 24 plots, each 2/5 of an acre, have been cleared of weed, levelled and harrowed with the aid of tractors. The padi nursery has been sown and it is intended to grow a crop of padi over the whole area. Difficulties have arisen in controlling the depth of water and it is hoped that these may be solved in time to start an experimental programme next year.

Agronomic Investigations and Extension

Agronomic investigations, which in 1958 were confined to Kedah and Province Wellesley, have this season been extended to Kelantan. In Kedah, the rains commenced early in the season and an early start there has been possible. Weather conditions in the State have remained satisfactory and at the end of the quarter the crop looked well. In Kelantan, wet weather was late in arriving and in areas where irrigation water was not avaible, sowing of nurseries has been delayed. In Province Wellesley, the off season crop was harvested in August and nurseries for the main season crop were put down in late September.

The padi agronomic research programme has been influenced by the conclusion drawn from last season's results, that greater attention needs to be paid to nursery management and manuring. The investigational programme has, therefore, been enlarged to include a series of trials designed to clarify the importance of nursery management, the types of manures required in the nursery and the optimum size of nurseries.

NURSERY INVESTIGATIONS

It would appear from progress to date that use of farmyard manure in wet nurseries is a desirable feature. By itself it is not entirely adequate but when used in conjunction with ammonium phosphate 11 : 48 it produced seedlings of very satisfactory quality. Furthermore, seedlings obtained from nurseries in which farmyard manure had been incorporated appear to recover more swiftly from transplanting. It would seem that a dressing of about ½ lb. of farmyard manure per square foot is now the optimum required to produce sturdy seedlings.

Ammonium phosphate 11 : 48 which, applied at the rate of 2 lb. per gantang of seed, is at the present time the standard fertilizer recommended for wet nurseries, appears to be quite satisfactory during the first two to three weeks after sowing, but seedlings then tend to show signs of nitrogen deficiency. Despite this, significantly increased yields are obtained from this treatment but it has been shown that urea, used in limited quantities as a top dressing, prevents the development of visual signs of nitrogen deficiency. There are indications that nitrogen deficiency symptoms do not appear when ammonium phosphate 21 : 53 or even 16 : 20 are used in place of ammonium phosphate 11 : 48. This aspect requires further investigation, as the Colombo Plan team have shown that too high a content of nitrogen in the seedling is reflected in poorer rooting ability when transplanted.

Indications from a factorial nursery manurial trial serve to confirm that nitrogen and phosphate in combination are the major manurial requirements in the nursery. There is a suggestion that a little added potash may be desirable, but in Kelantan, in particular, the use of potassic salts containing a chloride radicle had a most serious adverse effect. The range of variation in seedling growth between treatments which has appeared in this trial lead to considerable speculation as to quantitative requirements.

It would seem that limestone has had no noticeable effect on growth of seedlings in the nursery. Increasing nursery size has, however, produced definite differences and it would seem that a nursery of an area of 700 sq. ft. per gantang of seed, manured with 4 lb. of ammonium phosphate, is near optimum.

In Kelantan, on poor sandy soils, seedlings produced in dry nurseries benefited a great deal from incorporation of farmyard manure in the nursery bed. One to one and a half pounds of F.Y.M. per sq. foot of bed is, in these circumstances, considered to be a suitable dressing. Both limestone and double super-phosphate had very little effect in the presence of F.Y.M. but when double superphosphate was used alone at a rate of 10 lb. per 500 sq. ft. severe leaf scorch occurred.

In Province Wellesley the Colombo Plan officers have shown that there are certain advantages in the use of raised semi-dry nurseries. Seedlings appear to produce new roots more quickly on transplanting than seedlings from wet nurseries and therefore recover more quickly. Furthermore, it has been shown that a top dressing of nitrogen two to three days before transplanting sometimes further improves the ability of seedlings to root at transplanting. In contrast to wet nurseries, sowing density appears to be of less importance in dry nurseries.

Field Investigations

In Kedah, a trial designed to clarify the effect on yield of planting overage seedlings or substituting seedlings of a shorter term variety from a resown nursery, has demonstrated that the resown seedlings show a greatly improved rate of recovery.

The Colombo Plan team working in Province Wellesley have produced interesting results from their off-season trials. It has been shown that greater density of planting is justified in terms of increased yield per acre, but needs to be accompanied by improved field cultivation and husbandry for the full yield potential to be realised. Too narrow spacing of hills in the row is not desirable and seedlings should be transplanted no deeper or shallower than two inches. Investigation of the use of herbicides for weed control has shown that preplanting with P.C.P. applied at not more than 10 lb. per acre followed by 2 : 4D at 0.75 lb. of acid equivalent per acre, gave satisfactory control of weeds but failed to produce a significant increase in yield.

The Colombo Plan team showed that at Bukit Merah Padi Experiment Station the nitrogen requirement of padi was quite high, whereas phosphate requirement was lower than anticipated; 60 lb. N. and 30 lb. P_2O_5 per acre were required. The importance of placement of nitrogenous fertilizer between the surface oxidising layer of soil is emphasised in the investigations, and earlier work on the desirability of placement of phosphatic fertilizer has been confirmed. Use of furnace slag has not proved to be necessary on relatively fertile soils, but may have an application on sandy soils in, e.g., Kelantan. Iron ore, however, has had a beneficial effect in counteracting root damage caused by H_2S released under reduced soil conditions. The benefit is further increased if additional nitrogen is applied to the growing crop.

Investigations suggest that the hypothesis that nitrogen is best applied as both a base and top dressing is substantially correct. It would appear that the top dressing is best applied at ear initiation but this feature is under further investigation on the main season crop in Kelantan, Kedah and Province Wellesley.

A number of hand tools have been tried out for interrow cultivation and weeding of padi. The only implement which is satisfactory for transplanted wet padi is a rotary hand weeder designed in Japan. This functions well at a water level of between 1 and 3 in. but it functions with increasing difficulty in deeper water. The machine has proved to be sufficiently satisfactory to warrant its use for extension purposes.

A number of tools have been found satisfactory for use between drilled padi before the field is flooded. The best of these are a Dutch weeder with a wave cut blade sharpened on both sides and a 'Wolf All-share' weeder. The satisfactory use of these implements, however, is dependent on the land having been properly prepared beforehand.

The contour levelling of land and *bendang* has been completed at the Padi Mechanisation Scheme, Parit. This, it is thought, brings to a close the teething troubles from which the scheme has suffered and means, in effect, that the whole station can this season be used for the cultivation of padi. Useful information on problems associated with mechanised off-season cropping has been obtained from the scheme and plans have been developed for the next off-season.

A programme designed to study the practicability of selecting

sites at random for crop cutting tests and ancillary studies on cultural practices, stem borer damage, etc., has been initiated in Kedah. The first stage of locating 560 random fields for subsequent studies has been completed.

CROP REPORT

Small areas of padi in Negri Sembilan (2,253 acres), Pahang (25 acres) and Johore (160 acres) were harvested in June to complete the harvest of the 1958/59 crop. This small acreage did not materially alter figures of acreage harvested and yield, given in the previous quarterly report.

Planting of off-season padi was completed during the quarter in Kedah (1,125 acres), Kelantan (470 acres), Trengganu (150 acres), Province Wellesley (9,851 acres) and Perak (45 acres). The total area of 11,641 acres planted shows an increase of 47 per cent over the area of off-season padi planted in 1958. There was an increase of over 700 acres in Kedah and over 2,000 acres in Province Wellesley. In Kelantan 470 acres were planted in the Salor Irrigation area after previous attempts in 1953, 1954 and 1955 had failed. In this area a most impressive average yield of 505 gantangs per acre was achieved. At the end of the quarter harvesting was complete in all States except Kedah and the overall estimated average yield was 422 gantangs per acre giving a gross yield to date of nearly five million gantangs. Average yield per acre in the 1958 season was 400 gantangs and the final gross yield was a little over three million gantangs.

The estimated total area of padi to be planted in the 1959/60 main sason is 880,000 acres compared with 859,850 acres in the 1958/59 season. Planting was almost completed in Perlis, Kedah and Malacca during the quarter. Elsewhere planting completed ranged from 6.5 per cent in Selangor to 69 per cent in Pahang. Actual acreage planted was 559,513 representing 63.4 per cent of the total acreage to be planted.

Clear demonstration has been obtained throughout the Federation of consistent increases in yield obtained by nursery manuring with ammonium phosphate 11 : 48 at the rate of 2 lb. per gantang of seed. Considerable efforts are being made to encourage planters to manure their nurseries and to adopt other methods of good husbandry.

The estimated total area to be planted with lowland dry padi this season is 36,222 acres; the total area planted last season was 33,810 acres. To date this season 31,808 acres have been planted. Similarly, an increased planted acreage is anticipated for upland dry padi; 26,542 acres are expected to be planted—an increase of nearly 3,000 acres on last season's planted acreage. By the end of the quarter 25,311 acres had already been planted.

Rubber

Distribution of rubber planting material to smallholders for new planting and replanting amounted to 124,913 yards of budwood and

1,629,905 stumps. These figures emphasise that although the demand for clonal seedling stumps has risen, most of the considerably increased demand for planting material is for budwood. This portrays a logical and desirable development in the smallholder rubber industry.

Coconut

A further 35 acres of land at Telok Bahru have been drained and levelled and 297 selfed and open pollinated seed nuts put into nurseries. There is a serious shortage of seedlings for this season's planting programme and the quality of the seedlings themselves leaves much to be desired. This situation reflects the poor condition of the palms at the abandoned coconut station at Port Swettenham and has forced a decision to conclude all attempts to produce further planting material from this station. Rhinoceros beetle (*Oryctes rhinoceros* Linn) continues to cause serious damage to the young palms and attempts to bring the pest under control have met with little success.

Manurial trials at the Federal Experiment Station, Serdang, and on smallholders land at Batu Rakit, Trengganu, have been maintained. Application of an NPK fertiliser at the rate of 7 lb./palm/annum in the latter trial continues to provide noticeable increase in yield of nuts but a further increase attributable to doubling the rate of application is of little significance.

After the precipitate rise in the price of copra during the latter half of 1958 and early 1959 and the steadying of prices at between $40 and $45 per pikul in mid-1959, a general drop in price occurred during the third quarter. Good quality copra realised $35 to $40 per pikul.

Coconut demonstration plots incorporating the use of manures, control of noxious weeds and pests and improved drainage where necessary have now been initiated on smallholders' land in Perak, Johore, Kelantan, Penang, Pahang and Trengganu. Considerable interest by smallholders is reported and it is hoped that these plots will lead to permanent improvement in standards of management amongst neighbouring holdings.

Malay coconut smallholders in the Bagan Datoh and Dindings areas, Perak, continue to apply for loans from the Planters Loans Board for improvement of drainage and control of noxious weeds. Loans are advanced after investigation by the staff of the Department who now report that improvement in the condition of the palms on holdings which first received loans is clearly noticeable.

Coffee

Trials designed to determine the nutrient requirements of coffee on deep peat soils have been continued at the Federal Experiment Station, Jalan Kebun. Preparations are in hand for the amendment of certain field trials to permit investigation of the need for foliar application of iron and magnesium, both of which have from time to time appeared as deficiencies.

The acreage of coffee has more than doubled from 7,400 acres in 1951 to over 15,000 acres in 1959. Total local consumption of coffee is estimated at about 5,000 tons per annum and estimated production is in the region of 4,500 tons per annum. Malaya is therefore almost self-sufficient in coffee and further increases in acreage are required only to keep pace with increased consumption.

Although local prices for Liberian coffee have fallen over the past five years, they have not fallen to the same extent as world prices. Prices have steadied in 1959 and have tended to rise again. The price at Klang of dried Liberian coffee beans at the end of September was $160 per pikul, an increase of $10 per pikul over the quarter and an increase of $25 per pikul over the previous six months.

Cacao

Further experiments were done using the fungi *Botroyodiplodia theobromae* to induce die-back but no positive results were obtained.

The 64 pot factorial experiment to investigate "seedling wilt" has been completed. The plants were removed and the weights of stems and leaves recorded. Of the beneficial treatments, calcium plus magnesium is highly significant, phosphorous and potasium are significant but the nitrogen treatment was found to be significantly detrimental.

The condition of mature cacao at the Federal Experiment Station, Jerangau, continues to improve. Limestone and phosphate applied to established cacao trees in a factorial trial continue to emphasise both the need for these nutrients and the importance of their interaction effect. There has been no response in this trial to application of manganese as a foliar spray.

It has been shown in investigations that trade preparations with Dalapon and mixtures of 2 : 4D and 2 : 4 : 5T are not satisfactory for use in controlling grass weed in cacao, as both cause scorching of cacao foliage at concentrations required to obtain a kill of the grass. Sodium chlorate however has proved to be satisfactory and further investigations are in progress.

Fruit

The herbarium in the Botanical Division now contains material from 150 different origins and 118 of those are also represented as seedlings in the nursery at Kuala Lumpur. The survey of citrus varieties and species growing in Malaya was continued in Perlis, Kedah, Penang and Province Wellesley. Reports were received on the severe occurrence of the pest citrus leaf-miners, from several sources. In Kedah it was reported that Endrex proved very effective against this pest. Experiments were carried out using other insecticides and it was found that Basudin is equally as effective as Rogor 40. The latter, however, causes scorching of the leaves and of these two Basudin is, therefore, the more promising for use against leaf-miners.

An investigation in hand at the Federal Experiment Station, Serdang, to clarify the relative merits as root-stocks of rambutan seedlings derived from open pollinated flowers of the better known clones, serves to indicate that seedlings of the variety R.10 'Azimat' are promising. It was shown some years ago that R.9 was desirable for this same purpose, hence there are now two clones the seed of which are provisionally considered quite suitable for use as rootstocks.

Seedling rootstocks for citrus rootstock trials to go down at the Federal Experiment Stations, Telok Bharu and Gajah Mati, are being produced at the Federal Experiment Station, Serdang. One of these, *Poncirus trifoliata* is very slow in development and it is possible that it will have to be excluded from the trial. The chief merits of this rootstock are its high degree of resistance to root rot and gummosis (*Phytophthora citropthera*), its ability to induce regular precocious cropping and its frost and drought resistance. Resistance to frost has no significance in Malaya but resistance to gummosis is of considerable importance and it will be unfortunate if, in fact, this rootstock cannot be used.

As forecast by the severe drought in many parts of the Federation during the early part of the year resulting in premature fruit drop, the mid-year fruit harvest was generally light.

The harvest of fruit was particularly light in Kelantan, Penang, Perak and Trengganu, fair in Johore and Kedah, and relatively heavy in Malacca and parts of Pahang. Rambutan, durian, mango, mangosteen, langsat, duku and rambai were in season. There was a small harvest of Mandarin orange in Lower Perak, Johore and Negri Sembilan.

From the light flowering of rambutans and durians in South Perak it is anticipated that the end of the year harvest will not be particularly heavy.

Demonstrations of dusun renovation by pruning, weeding, manuring, felling and replacig old trees are being carried out by the Department in most States, particularly in Kelantan, Kedah, Perlis, Pahang and Trengganu.

Large stocks of budgrafted fruit trees are available in Johore (12,688 plants) and Perak (7,900 plants). It is anticipated that these will be distributed during the forthcoming quarter when weather conditions are particularly suitable for planting.

Tea

Preliminary examination of results from a trial at the Federal Experiment Station, Cameron Highlands, designed to test the comparative values of varying degrees of pruning severity suggests that difference in yield between treatments is very small. It is thought to be unlikely that differences between treatments will prove to be significant and this suggests in turn that severity of pruning may not be a very important factor in the highlands.

Foodcrops

During the padi off-season groundnuts were grown on the 'bris' soils from Kelantan. All the treatments with phosphate made satisfactory growth. It was noticed that the best yield was given in tanks which had peat in addition to major and trace elements. It is possible that the capacity of peat to retain moisture may have been responsible for the higher yields. The calculated yield of groundnuts per acre in the best treatment amounted to 1,880 lb. which is equal to that obtained from fertile soils. Soya beans were planted after the removal of the groundnuts and they made good growth in all tanks which were fertilised with phosphate. The soya beans have been dug in as green manure for padi which has just been transplanted.

Results obtained from a potato spacing observation at the Federal Experiment Station, Cameron Highlands, suggest that close spacing of tubers, i.e., 24 in. x 10 in., is responsible for increase in yield. Yields at various wider spacings were invariably lower.

Japanese varieties of a number of vegetables under casual trial at the Federal Experiment Station, Cameron Highlands, have shown very little promise. One or two brassicas and sweet peppers tried in the lowlands, however, appear to be promising.

Pests and Diseases

The final experiment was completed in a series of pot trials to compare the effectiveness of seven insecticides in controlling stem borers. Of the seven insecticides tried (D.D.T., B.H.C., Endrex, Malathion, Basudin and Rogor 40) all at the rate of 1 lb. active ingredient per acre, it was confirmed that Endrex was the most effective in controlling the pest and producing the highest yield. The next best was found to be Dieldrex. Unfortunately neither of these insecticides can be used in the field due to their high toxicities to fish and animals.

Dipterex is said to have a low mamalian toxicity and has been used by Dr. Koyama in his experiments at Krian. The Entomology Division used it for the first time in the following experiments.

(a) to compare the effectiveness of Dipterex and Ekatox in controlling stem borers. Dipterex was the more effective but results are not conclusive.

(b) to compare the effectiveness of Dipterex at 0.07% and 0.05% active ingredient. Results of the experiment show that the percentage of dead stem borers in both tests are about the same.

It was observed during this second trial with Dipterex that the stem borers in different larval instars reacted differently to the insecticides and in a further experiment it was shown that the younger stem borers (half grown and small) are more susceptible to Dipterex treatment.

A pathogen known as *Ganoderma lucidum* is causing a good deal of concern to some oil palm estates. It attacks the base of the trunk

which results in wilting and death of the palms. In some estates where infestion is merely local, the diseased region of the stem is carefully excised and the exposed stem tissue is disinfected and painted with a protectant chemical. In other cases the fruit bodies of the fungus are collected and destroyed and diseased palms felled and burnt. It is not known if these measures are adequate and some preliminary experiments were carried out to study the history of the disease and the region of entry of the pathogen, whether through roots or exposed stems or leaf bases. This work will be continued.

One oil palm estate in Perak was sprayed with Endrex from an aeroplane to control bagworms, *Cremastopsyche pendula* and the treatment was found to be very effective.

Soil Survey

During the period under review, soil reconnaissance surveys were carried out mainly in south and central Kedah. In south Kedah, road reconnaissances were carried out along the Bandar Bahru-Selama-Kulim "triangle" where a new soil series was discovered. A detailed road reconnaissance was also carried out in the Kuala Ketil-Kulim-Mahang-Tawar "quandrangle." Soils in this area consist of Gajah Mati and Rengam soil associations and the boundary between these two soils has been fairly accurately delineated. A reconnaissance survey was also carried out in the Baling, Weng and Kroh areas. Here the soils have been all grouped together as the Weng complex.

In north Kedah, work was continued along the Nami-Sik military road. As a result of this it was possible to map the soil boundaries between the main soil associations.

The soil survey team have now completed the field work necessary for the production of a schematic soils map of Kedah State and this is now in the course of preparation together with a memoir on the soils of Kedah.

The reconnaissance soils survey of Kelantan was continued and reconnaissance soil trips were carried out in the Sg. Lebir, Sg. Aring and Sg. Neggiri valleys and in the area around Gua Musang. The field work has been concluded and the information obtained during three seasons field work is at present being plotted on to the latest topographic maps with a view to producing a schematic-reconnaissance map before the end of the year. A short report to accompany the map is also in course of preparation.

Agricultural Education at Rural Level

Rural agricultural training centres were in operation in all States during the quarter. The following are the number of courses and the number of trainees (including 16 military personnel) attending these courses, by States:—

	Attendance	*No. of Courses*
Perlis	36	3
Kedah	80	7
Penang	65	4
Perak	8 (Military)	1
Selangor	87	6
Negri Sembilan	41	2
Malacca	44	3
Johore	55	3
Pahang	32	2
Trengganu	72	6
Kelantan	110	10
Total	630	47

Construction of new buildings for the Rural Training Centre in Degong Agricultural Station, Perak, commenced during the quarter.

A fully equipped mobile extension unit has been established in Kelantan. This unit consists of a vehicle and a trailing caravan and is equipped with all forms of visual aids, including cine and slide projector, and with stocks of planting material, insecticides, fertilisers, etc. In September the unit visited eight areas in Kelantan and an estimated 6,700 farmers attended.

A similar unit on loan from the Commissioner of Community Development was operated by the Department in Trengganu during the quarter. This unit visited eleven areas in five districts and attracted about 7,000 people during the day and some 23,000 at nights when films were shown. Talks were given on improved methods of padi planting, formation and purposes of Farmers Associations, and community development. Films on agriculture and community development were shown.

There is no doubt that mobile units of this nature are very valuable aids to agricultural extension and it is proposed to establish them in other States.

STAFF NOTES

(Period 1st July to 30th September, 1959)

Honours and Awards

Inche Basir bin Ismail, State Agricultural Officer, Trengganu, was awarded the *Pingat Jasa Kebaktian* by His Highness the Sultan of Trengganu, on 11th July, 1959.

Promotions

L. A. Vivian (Agricultural Officer)	Senior Agricultural Officer Grade A.	12.6.59

Secondments

The following officers have been seconded to the Malayan Agricultural Census Division, Ministry of Agriculture, until the end of June, 1961:—

Mr. T. B. Wilson to fill the post of Commissioner for Agricultural Census	1.1.59
Inche Mohd. Tamin bin Yeop to fill the post of Deputy Commissioner	1.8.59
Mr. S. Selvadurai and Mr. Lee Yoke Heng to fiill the posts of Assistant Commisioners, "Estates" and "Statistics", respectively	1.8.59

STATISTICS

April to June, 1959

Rubber.—The rubber price was well maintained around the dollar level for the second quarter, although sporadic fluctuations occurred, as usual, on rumours of changes in American stockpile policy. The average price of rubber, as quoted by the Singapore Chamber of Commerce Rubber Association, was as follows:—International Type I (R.S.S.I.) April, 94.90, May, 103.74, June, 96.18 cents per pound f.o.b.

A revised estimate of world production and consumption of natural and synthetic rubber during 1959 is given below (Natural Rubber Bureau).

	Natural	*Synthetic*	*Total*
	Consumption (1,000 tons)		
U.S.A.	540	1,060	1,600
Rest World	1,510	440	1,950
	2,050	1,500	3,550
	Production		
U.S.A.	—	1,320	1,320
Malaya	700	—	700
Indonesia	700	—	700
Rest World	590	250	840
	1,990	1,560	3,560

If this estimate is correct, more natural rubber will be consumed in 1959 than is being produced, with a consequent run down of world stocks.

Palm Oil.—Production of palm oil continued to improve and the price maintained its steady rise.

Copra and Coconut Oil.—The downward trend in production appears to have reached a halt and it may be that the excellent price has induced some rehabilitation of smallholders' palms that have been neglected in the past. Estate production has also been maintained nearly at the 1958 level for the period.

Table I

AVERAGE MONTHLY PRICES PAID BY LOCAL DEALERS FOR SMALLHOLDERS' RUBBER, APRIL TO JUNE, 1959

(dollars per pikul*)

Grades	Alor Star, Kedah			Seremban, Negri Sembilan			Johore Bahru, Johore		
	April	May	June	April	May	June	April	May	June
Smoked Sheet No. 1	107.13	113.71	107.08	106.51	113.72	106.07	106.61	114.48	105.62
Smoked Sheet No. 3	104.02	108.76	103.22	103.81	109.17	103.52	104.14	110.35	103.61

* 1 pikul = 133⅓ lb.

This table has been compiled from statistics supplied by the Chief Statistician, Federation of Malaya.

Table II

RUBBER PRODUCTION

FEDERATION OF MALAYA

(long tons, dry weight)

Month	Estates		Smallholdings (Estimated)		Total	
	1958	1959	1958	1959	1958	1959
January -	35,800	37,600	25,400	27,200	61,200	64,800
February -	28,800	27,900	22,900	21,200	51,700	49,100
March -	28,400	28,500	20,300	21,100	48,700	49,600
April -	26,600	28,800	18,200	19,300	44,800	48,100
May -	27,200	33,500	18,100	22,300	45,300	55,800
June -	31,200	33,800	21,800	24,200	53,000	58,000
July -	36,500	35,600	23,700	26,700	60,200	62,300
August -	34,000		24,600		58,600	
September -	33,700		23,500		57,200	
October -	35,000		23,000		58,500	
November -	32,000		20,000		52,000	
December -	41,000		30,000		71,000	
Total -	390,2000		271,500		661,300	
Total 1957 -	369,073		268,024		637,097	

This table has been compiled from statistics published by the Chief Statistician, Federation of Malaya.

Production on smallholdings (estates of less than 100 acres) is taken as the total of purchases from smallholders reported by licensed dealers.

Table III

AVERAGE PRICES PAID IN LONDON FOR TEA

(s.d. per lb.)

For the Week Ending	Malayan		Ceylon		Indonesian		India				Africa	
							Northern		Southern			
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
3-7-59	4	0.66	5	4.20		Nil	4	4.92	4	2.06	3	2.12
10-7-59	4	3.17	5	0.10		Nil	4	3.02	3	9.20	3	0.58
17-7-59	3	9.05	4	7.98		Nil	4	4.56	4	7.56	2	11.51
24-7-59	3	9.00	4	5.07		Nil	4	6.72	3	4.63	2	10.95
31-7-59	3	8.11	4	3.39	2	8.14	4	1.69	3	3.31	2	11.11
14-8-59	3	7.50	4	2.49		Nil	5	7.96	3	2.55	2	10.85
21-8-59	3	8.12	4	4.20		Nil	5	11.70	3	3.34	2	11.75
28-8-59	3	8.75	4	10.10		Nil	5	11.57	3	3.52	3	0.04
4-9-59	3	10.14	5	0.77		Nil	5	8.77	3	3.93	2	11.70
11-9-59	4	0.64	5	3.63	1	9.00	6	2.33	3	4.82	2	11.15
25-9-59	4	0.49	5	6.97	3	9.50	6	0.70	3	7.12	3	5.00

Table IV

AVERAGE DEALERS' PRICES FOR DRIED LIBERICAN COFFEE BEANS GROWN IN SELANGOR*

(dollars per pikul †)

For the Week Ending	Klang	Kuala Langat
	$	$
4-7-59	150.00	148.00
11-7-59	150.00	148.00
18-7-59	150.00	150.00
25-7-59	150.00	150.00
1-8-59	150.00	150.00
8-8-59	150.00	150.00
15-8-59	150.00	150.00
22-8-59	150.00	150.00
29-8-59	150.00	150.00
5-9-59	155.00	150.00
12-9-59	160.00	156.00
19-9-59	160.00	157.00
26-9-59	160.00	158.00

* These are not the prices paid to smallholders, who sell freshly harvested berries to dealers for processing.

† 1 pikul = 133⅓ lb.

Table V

PRODUCTION OF PALM OIL AND KERNELS AND PRICES OF PALM OIL

(long tons, as declared by estates)

Month	Production of Palm Oil (long tons)		Production of Palm Kernels (long tons)		Average Price per Ton of Palm Oil *		
	1958	1959	1958	1959	1959		
					£	s.	d.
January -	3,581	5,225	981	1,388	72	7	9
February -	4,460	4,824	1,192	1,356	73	13	6
March -	6,090	6,553	1,645	1,815	74	5	8
April -	5,748	5,268	1,552	1,404	75	1	9
May -	5,609	5,055	1,408	1,314	77	14	10
June -	5,782	5,931	1,398	1,565	78	11	5
July -	7,243	6,912	1,874	1,888	81	2	5
August -	6,939	7,005	1,832	1,958	83	7	0
September -	6,952		1,800				
October -	5,825		1,523				
November -	5,517		1,452				
December -	5,925		1,616				
Total -	69,671		18,273				

* F.O.B.

Table VI

PRODUCTION OF COPRA, COCONUT OIL AND COPRA CAKE FEDERATION OF MALAYA

(tons)

Month	Copra Production						Coconut Oil Production *		Copra Cake (Poonac) Manufactured	
	Estates		Smallholdings (estimated)		Total		Oil Mills		Oil Mills	
	1958	1959	1958	1959	1958	1959	1958	1959	1958	1959
January	2,449	1,827	1,857	8,000	4,306	9,827	8,164	4,195	5,136	2,709
February	2,546	1,947	8,100	1,500	10,646	3,447	5,458	3,556	3,397	2,298
March	2,895	2,377	7,028	6,000	9,923	8,337	7,032	4,027	4,469	2,643
April	2,910	2,523	8,421	6,000	11,331	8,523	6,032	4,636	3,905	3,041
May	3,275	3,097	11,123	8,000	14,398	11,097	7,223	5,327	4,690	3,519
June	3,431	3,338	3,447	13,000	6,878	16,338	7,485	8,385	4,886	5,499
July	3,985	3,779	8,572	9,000	12,557	12,779	7,828	5,880	5,183	3,964
August	3,575	3,445	9,200	9,000	12,775	12,445	7,168	7,343	4,669	4,734
September	2,769		5,400		8,169		7,168		4,620	
October	2,519		6,000		8,519		6,939		4,472	
November	2,134		4,000		6,134		4,351		2,805	
December	2,332		4,000		6,332		3,703		2,442	
Total	34,820		77,148		111,968		78,551		50,674	

Notes:—1. The above table has been compiled from statistics published by the Chief Statistician, Federation of Malaya.

2. Estate copra production and coconut oil production are as declared by estates and oil mills, respectively.

3. Statistics of smallholding coconut oil production are not available.

4. Smallholding copra production for commercial purposes is estimated from the formula: imports + estate stocks (opening) + estate production + smallholding production = exports + local oil mill consumption + estate stocks (closing).

* Includes both refined and crude oil.

Table VII

SINGAPORE PRICES OF VARIOUS AGRICULTURAL PRODUCTS

(dollars per pikul †)

Date	Copra, Sundried	Coconut Oil *	Pepper, F.A.Q. Muntok White	Pepper, Gen. Muntok White	Gambier, Cube	Sago Flour, Lingga	Tapioca Flour No. 1	Oilcake, Round
4-8-59	35.25	58.00	138.00	148.00	46.00	8.75	18.50	13.50
10-8-59	36.50	59.00	154.00	164.00	46.00	8.75	18.50	14.50
17-8-59	38.00	59.00	154.00	164.00	46.00	8.62	18.50	14.50
24-8-59	37.50	60.50	161.00	171.00	46.00	8.62	18.50	14.50
31-8-59	38.00	62.50	159.00	169.00	46.00	8.62	18.50	14.50
7-9-59	38.50	64.50	171.00	181.00	46.00	8.75	18.50	15.50
14-9-59	39.50	64.00	171.00	181.00	47.00	8.62	18.50	15.50
21-9-59	40.00	63.00	170.00	180.00	46.00	8.62	18.50	14.50
28-9-59	42.50	63.75	165.00	175.00	46.00	8.50	18.50	16.00

† 1 pikul = 133⅓ lb.

* F.O.B. in second-hand drums.

‡ Nominal.

The above prices are taken from the weekly reports of the Singapore Chamber of Commerce.

Table VIII

MALAYAN AGRICULTURAL EXPORTS, JANUARY TO DECEMBER, 1958. ‡

Product	Net Exports in Tons			
	Year 1955	Year 1956	Year 1957	Year 1958
Arecanuts	13,679	11,228	9,625	4,938
Coconuts, fresh †	72,140	34,779	37,466	52,340
Coconut oil	91,176	103,132	100,031	67,483
Copra	75,076 *	82,549 *	71,718 *	55,906 *
Copra cake	56,404 *	66,174 *	73,208 *	72,453 *
Gambier, all kinds	66	96	209	555
Palm Oil	52,832	55,252	56,728	67,818
Pineapples, canned	27,756	30,377	37,671	41,417
Sago, flour	23,053	21,483	15,581	21,652
Sago, pearl	5,483	4,276	4,021	3,104
Sago, raw	18,709 *	18,522 *	14,006 *	13,383 *
Tapioca, flake	475	260	403	350
Tapioca, flour	3,979 *	3,753 *	1,573 *	1,920 *
Tapioca, pearl	5,470	5,630	5,222	3,333

† hundreds. * net imports.

‡ Statistics compiled from "External Trade of Malaya" (Colony of Singapore and Federation of Malaya) December, 1958.

METEOROLOGICAL SUMMARY, MALAYA, MAY, 1959

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of		Means of A and B	Absolute Extremes				At 4 foot	At 1 feet	Total		Most in a day	Number of Days					Total	Daily Mean	Per cent.
	A. Max.	B. Min.		Highest Max.	Lowest Min.	Lowest Max.	Highest Min.						Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
								o F	o F			Amt.								
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak	93.2	74.2	83.7	98.2	67.0	89.8	77.7			9.41	239.0	1.64	15	12	6			216.05	6.97	
Kuala Lumpur, Selangor	92.6	74.7	83.7	96.3	70.6	87.8	76.8			13.18	334.8	2.78	15	14	12	3	1	227.75	7.35	
Sitiawan, Perak	89.9	74.5	82.2	93.2	71.2	85.4	77.1	84.8	85.0	5.83	148.1	1.28	12	13	4	2				
Kuantan, Pahang	89.5	73.4	81.4	92.1	70.1	85.3	76.0	84.2		6.05	153.7	1.47	17	13	10	7		174.45	5.63	
Bayan Lepas, Penang	89.1	75.5	82.3	91.9	72.2	85.6	78.1			5.81	147.6	1.26	15	10	7			226.95	7.32	
Malacca	89.0	74.5	81.7	92.2	71.4	83.2	77.3			4.32	109.7	1.17	14	22	5			217.45	7.01	
Mersing, Johore	82.6	73.2	80.9	91.0	70.6	83.6	76.1			2.67	67.8	0.43	13	10				212.70	6.86	
Alor Star, Kedah	91.0	75.0	83.0	95.0	72.3	82.4	78.0			15.99	406.1	2.57	16	13	7	1		843.25	7.85	
Kota Bharu, Kelantan	89.5	75.7	82.6	92.7	73.4	83.4	78.8	87.1	87.4	7.43	188.7	4.20	10	10	5	1		241.70	7.80	
K. Trengganu, Trengganu	88.4	74.6	81.5	91.3	72.2	81.7	77.0			4.98	126.5	1.70	9	7	2			217.65	7.02	
Singapore	89.1	75.7	82.4	92.9	73.0	83.5	77.4			6.90	175.3	0.98	13	12	6			165.55	5.34	
HILL STATIONS																				
Cameron Highlands, Tanah Rata, Pahang. (3750 ft.)	74.7	57.5	66.1	79.0	49.0	72.0	62.2			7.64	194.1	1.22	21	21				146.25	4.72	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, JUNE, 1959

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of		Means of A and B	Absolute Extremes				At 1 foot	At 4 feet	Total		Most in a day	Number of Days					Total	Daily Mean	Per cent.
	A. Max.	B. Min.		Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	° F	° F			Amt.	Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak	92.7	74.3	83.5	97.6	70.6	86.2	77.0			7.83	198.9	3.50	10	8	1			199.35	6.65	
Kuala Lumpur, Selangor	91.0	74.8	82.9	95.7	72.2	86.1	76.4			5.99	152.1	0.95	17	13	9	3		190.90	6.36	
Sitiawan, Perak	90.1	74.5	82.3	92.9	72.2	85.0	77.2	85.5	86.2	3.86	98.0	1.78	9	5		1		196.05	6.53	
Kuantan, Pahang	89.5	73.1	81.3	92.0	70.9	85.1	76.0	84.3		8.16	207.3	4.80	11	7	8	1		189.40	6.31	
Bayan Lepas, Penang	88.9	75.4	82.1	92.8	73.0	85.0	78.1			9.15	232.4	2.55	14	11	5		7	199.90	6.66	
Malacca	87.8	73.5	80.7	72.2	70.2	82.7	75.8			8.95	222.3	1.66	16	13	6	1		179.85	5.99	
Mersing, Johore	88.0	72.7	80.3	91.1	71.3	82.0	74.3			4.35	110.5	1.04	14	14	1		1	186.10	6.20	
Alor Star, Kedah	89.8	75.0	82.4	94.8	72.4	84.7	77.3			6.83	173.5	1.92	15	14	1			194.45	6.48	
Kota Bharu, Kelantan	90.1	75.4	82.7	93.2	73.3	85.0	77.2	88.8	88.1	2.36	59.9	1.67	7	5	3		1	205.00	6.83	
K. Trengganu, Trengganu	89.8	74.3	82.1	92.7	70.4	83.8	77.0			5.12	130.8	2.19	6	6	2			216.00	72.0	
Singapore	87.6	75.3	81.5	92.1	72.0	79.0	78.3			9.13	131.9	2.58	17	14	4			151.95	5.07	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	74.2	56.5	65.3	77.2	50.4	69.4	62.0			6.38	162.0	1.27	20	18				134.00	4.47	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, JULY, 1959

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes				At 1 foot	At 4 feet	Total		Most in a day	Number of Days					Total	Daily Mean	Per cent.
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	° F	° F			Amt.	Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak	92.7	73.3	83.0	96.2	70.8	88.0	77.0			3.63	92.2	1.23	11	9	2			212.40	6.55	
Kuala Lumpur, Selangor	89.9	73.4	81.7	94.0	71.3	81.9	77.6			5.70	144.8	1.89	10	7	4			208.05	6.71	
Sitiawan, Perak	89.3	72.8	81.1	92.4	69.9	81.4	75.1	84.8	86.2	7.49	190.2	3.21	13	10	8	1		215.90	6.96	
Kuantan, Pahang	88.8	72.2	80.5	92.1	67.3	82.0	75.9	83.2		4.48	113.6	1.40	9	6	6	2		184.40	5.95	
Bayan Lepas, Penang	88.2	74.6	81.4	90.6	71.8	82.6	77.8			3.36	85.3	0.74	9	8	10		1	204.80	6.61	
Malacca	86.7	72.8	79.7	89.9	69.8	80.5	77.2			9.96	253.0	1.83	18	14	11			185.05	5.97	
Mersing, Johore	87.0	71.8	79.4	92.0	68.2	81.6	77.0			14.96	380.0	3.50	19	19	10		5	181.95	5.87	
Alor Star, Kedah	88.6	74.0	81.3	92.7	70.5	82.7	75.5			9.21	233.9	2.18	16	15	3			196.15	6.33	
Kota Bharu, Kelantan	88.3	73.8	81.1	91.2	70.6	85.0	76.6	84.6	85.7	8.77	222.8	1.98	17	16	11		3	199.20	6.43	
K. Trengganu, Trengganu	87.6	73.1	80.3	91.0	70.3	82.9	76.3			10.31	261.9	2.92	19	13	7			197.05	63.6	
Singapore	88.4	75.7	82.1	91.8	72.3	83.0	79.8			3.52	89.4	1.01	13	11	6			188.20	6.01	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	72.8	56.2	64.5	76.5	52.0	64.6	61.4			3.33	8.46	1.03	11	10				151.90	4.90	

Compiled from returns supplied by the Malayan Meteorological Service.

Wiping makes doubly sure..

The spread of lallang demands vigorous measures for control. Spraying and wiping with Shell Lallang Oils will destroy lallang and render ground ready for replanting. This is the surest and safest method. Whatever the method employed, it is necessary to spray and wipe with Shell Lallang Oils to complete the destruction. Make *sure* of control by spraying and *doubly sure* of eradication by wiping with . . .

SHELL LALLANG OILS

SHELL

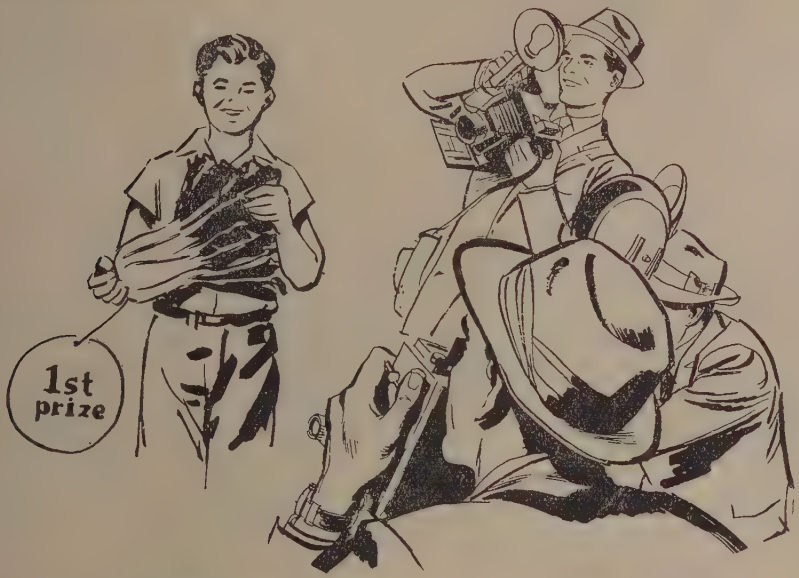
Twenty four hours

Termites work every minute in their search for food, doing untold damage to young rubber. Most of their damage is done below ground and prompt action must be taken to stop the invasion immediately it is discovered. Dieldrin is the answer to this problem. Used as a spray, Dieldrex 15, an emulsible form of dieldrin, at the rate of 2 fluid ounces to $3\frac{1}{2}$ gallons of water, will exterminate termites. The residual effect is long lasting.

For further information on pest control, please consult your nearest Shell branch.

the ideal estate insecticide **Dieldrex 15**

SHELL



BIAN HENG & Co., (M) Ltd.

(SPECIALIZED IN FERTILISERS)

ALL ANALYSIS ARE GUARANTEED
ACCORDING TO SPECIFICATION.

HEAD OFFICE:

137-A, Cecil Street, Singapore, 1. Tel. 25663.
Tel: 26281 & 32351. Ext. 20. P.O. Box No. 2745.

Sub Office:

295, Paya Lebar Road (Junction of Air Port Road) Singapore-19. Tel: 89489.
Tampin:— Tel:43.

Singapore (Kranji) Works Godown:— Tel: 69143.
Seremban Works Godown:— Tel: Seremban 1500.
Petaling Jaya Godown:— Prai Works Godown:— Tel: Prai 209.

Mr. Wee Sue Hang (Kelantan Representative)
339-D, Jalan Sultanah Zainab, Kota Bahru. Tel: K.B. 434.

We assure all our customers, however small or big, of our prompt service and courteous attention at any time.

The NEW 65

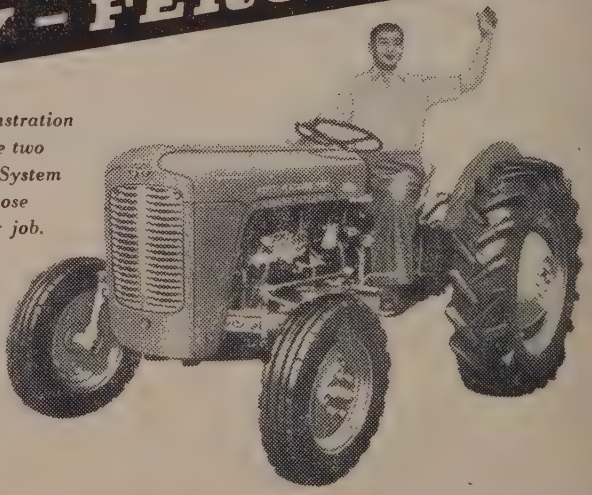
It's a FERGUSON SYSTEM Tractor with MORE power!

This useful "big fellow" is newly offered additional to Malaya's favourite, the MF 35 as "The bigger tractor for the bigger job."

The FERGUSON SYSTEM

MASSEY-FERGUSON 35

Ask for a demonstration — compare these two great Ferguson System tractors and choose the one for your job.



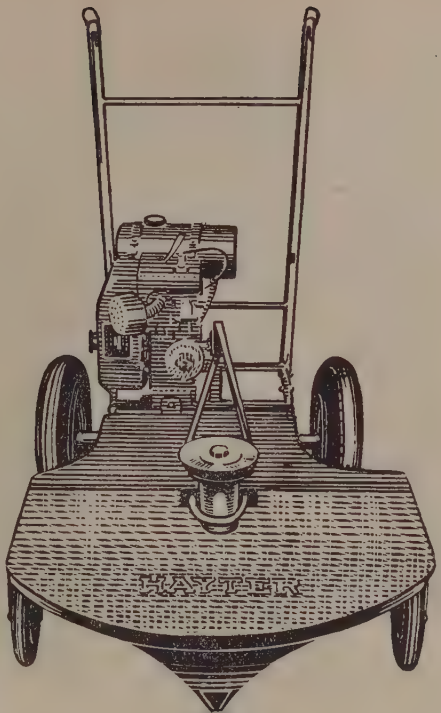
Once again go years ahead with Massey Ferguson-manufacturers of the latest and greatest in Agricultural equipment.

BORNEO MOTORS

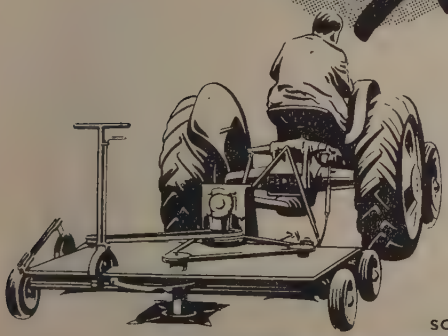
Singapore, Kuala Lumpur, Ipoh, Malacca, Penang, Seremban, Butterworth, Jesselton, Kuala Belait, Kuching.

it revels in the rough

The "Hayter" Motor Scythe, illustrated at right, is in its element in tough grass or lallang, on padang, sports field or private lawn. Of sturdy build, and easy to handle, the "Hayter's" cutting height may be quickly and positively adjusted. The actual cutters may be quickly sharpened with an ordinary reaper file. Powered by a MARK 12—4-stroke—"Villiers" engine (guaranteed 6 months), this is a scythe you can rely on.



ROTARY
HAYTER Grass Cutter



The heavier model, at left, is an invaluable machine on Plantations, Estates, Padangs and Airstrips. We would welcome the opportunity of discussing this machine's advantages with you.

SOLE AGENTS

JAMES WARREN

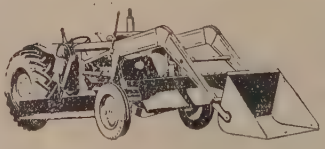
KUALA LUMPUR · SINGAPORE · IPOH

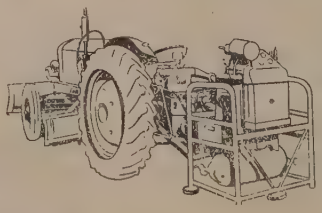
THE IDEAL GRADER FOR ESTATES & GENERAL MAINTENANCE

AVELING-BARFORD
MAINTENANCE GRADER

Here is a grader which will handle at low cost many of the smaller jobs which hitherto, larger machines had to be employed. This new machine, with a working weight of 8,000 pounds and a big 42 B. H. P. Diesel motor, is capable of moving astonishingly large amounts of earth.

An excellent machine for speedy, low cost Estate Road construction and maintenance.





Front End Loader

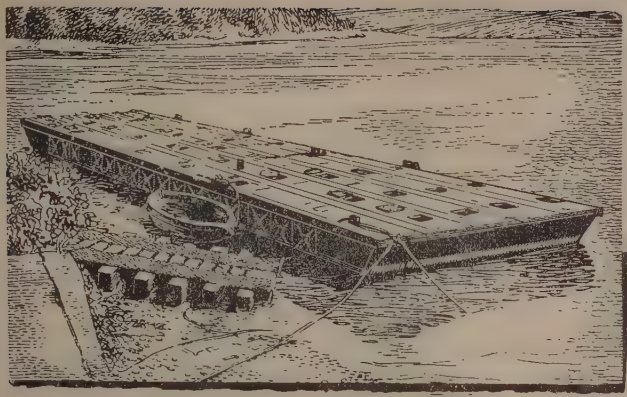
For moving or loading sand, gravel, soil or rubble.

Portable Air Compressor

For demolition and construction jobs of all kinds. Mounted on hydraulic lift linkage for easy transportation between jobs.

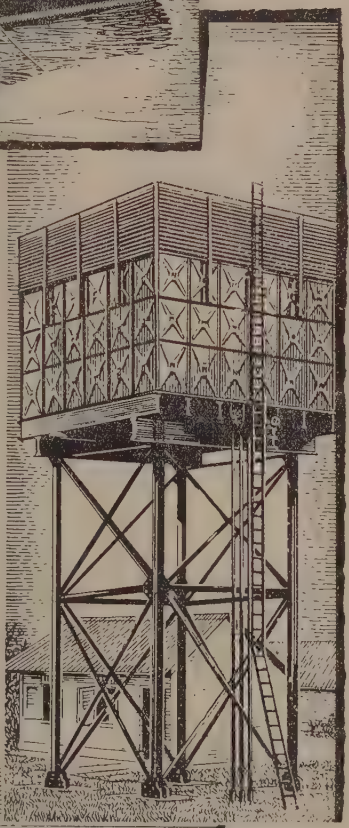
* SOLE DISTRIBUTORS
THROUGHOUT MALAYA & NORTH BORNEO

Wearne's
agricultural and heavy equipment division
KUALA LUMPUR — PENANG — IPOH — SEREMBAN — MALACCA
and at FEDERATED MOTORS LIMITED, SINGAPORE

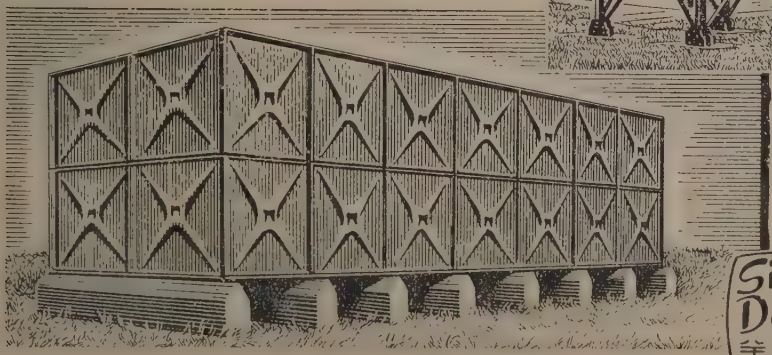


★ PONTOONS
★ ELEVATED TANKS
★ OIL STORAGE TANKS

All sizes available
from 400 gallons upwards



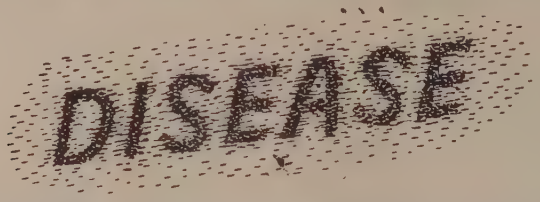
BRAITHWAITE



ask us to quote

Sime Darby 美那森

ANY WATER CAN CARRY . . .



TERRIBLE DISEASES such as Cholera, Typhoid, Dysentery and many others are carried by water and have plagued MAN for centuries.

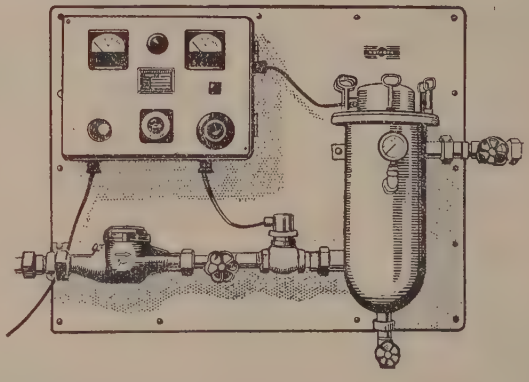
IT IS WELL TO REMEMBER that no water is safe—no matter how "CLEAR" it looks—unless due precaution has been taken to STERILISE it before drinking.

The latest Popular Technique is by passing it through

" ELECTRO - KATADYN "

WATER PURIFICATION PLANT (WORLD PATENTED)

because:—



1. It uses No Chemical, therefore free from pungent smell and taste, and is Non-Corrosive.
2. It is fully automatic and simple to use.
3. It is absolutely SAFE even if accidental overdosage occurs.
4. It produces highly activated water to resist re-infection.
5. It prevents Algae formation.
6. It is GUARANTEED that the treated water will correspond bacteriologically to British and American Standard of POTABLE Drinking Water.
7. It has output capacities from 9600 to 1,728,000 gallons per day or more.

For smaller capacities suitable for household use, ranging from 38 to 900 g.p.h. of SAFE WATER, the "KATADYN" FILLER/STERILIZER is available.

For your requirements, contact:

The Exclusive Agent and Stockist for Malaya, Singapore, Br. North Borneo.

SPOTRADIO LIMITED

58, Orchard Road, Singapore, 9.

Phone: 37734 Showroom — Phone: 25642 Office & Accounts

THE *VERY LATEST*
Electrolux REFRIGERATOR

- ✳ *Capacity 7.6 cu. ft.*
- ✳ *Big frozen food compartment*
- ✳ *5 ice trays*
- ✳ *2 vegetable drawers*
- ✳ *Door rack for eggs, compartments for butter and cheese*
- ✳ *Adjustable door shelves*
- ✳ *For operation by kerosene or electricity*

Silent cooling unit guaranteed 5 years

Sime Darby 黃耶森

Electrolux L.76

HERE is refrigeration in the grand manner. Luxuriously appointed with the most modern refinements, the new Electrolux L.76 has more than 14 square feet of shelf space, with every square inch carefully designed for practical use. Its lovely modern lines and delightful colour scheme will grace any kitchen or bar. You can depend on Electrolux too—the *original* silent refrigerator without moving parts . . . with the world-wide reputation for complete reliability. Come and see the range of models.

J163A

NEW PUBLICATIONS OF THE INDIAN CENTRAL COCONUT COMMITTEE

(1) The Coconut Palm — A Monograph :

Compiled by Dr. K.P.V. Menon, Director, Central Coconut Research Station, Kayangulam, and Dr. K.M. Pandalai, Joint Director, Central Coconut Research Station, Kasaragod, "The Coconut Palm—A Monograph" is a comprehensive treatise on all problems connected with the coconut industry and fills a long gap in scientific information that has accumulated in coconut research during the last two decades.

The book contains 384 pages of size 8¾" x 11½", 150 illustrations and 19 colour plates. It has been priced at Rs. 43/- Sh. 90/- $13.00 (including postage, packing and forwarding charges) a copy.

(2) The Coconut Atlas of India :

A beautifully illustrated publication containing maps, charts and graphs depicting in a simple and effective manner acreage and production of coconuts in India and the world, trends in import and export and trends in prices of coconut, copra and coconut oil in India and some of the important coconut growing countries of the world.

Beautifully printed on offset paper with rexine cover the book contains 88 pages of size 11½" x 9" and is priced at Rs. 18/- Sh. 40/- 36.00 (including postage, packing and forwarding charges) a copy.

For copies please write to:—

THE SECRETARY,
Indian Central Coconut Committee,
Ernakulam.

NEW PUBLICATIONS

"West Johore Coconut Production Survey"

Bulletin No. 104, by T.B. WILSON, Agricultural Economist.

This Bulletin, covering one quarter of Malaya's total Coconut acreage, contains factual information on falling productivity and recommendations for the rehabilitation of the area.

Price **$1.25** or **3 shillings** (Sterling)

"Reconnaissance Soil Survey of Trengganu"

Bulletin No. 105, by Wm. P. PANTON, Geologist.

A limited number of copies of this Bulletin will be available to the public. It contains a new set of soil maps for the area and a detailed description of the soils to be found in the region surveyed, with illustrations.

Price **$6.00** or **14 shillings** (Sterling)

"Mineral Deficiency Symptoms of Cacao Grown in Sand-Culture"

Bulletin No. 107, by Dr. R.G. LOCKARD, P. VAMATHEVAN and S. THAMBOO.

Thi Bulletin contains the results of experiments on deficiencies and interactions of macro and micro nutrient elements, with illustrations in colour and black and white.

Price **$4.00** or **9s. 6d.** (Sterling)

Available from:-

THE DEPARTMENT OF AGRICULTURE,
Federation of Malaya,
Kuala Lumpur.

FISONS PEST CONTROL LIMITED

GIVE YOU PROTECTION FOR

COVER CROPS ON RUBBER ESTATES

PINEAPPLES

OIL PALMS

VEGETABLES

COCONUTS

ROGOR 40

THE SAFEST SYSTEMIC INSECTICIDE

ESPECIALLY EFFECTIVE AGAINST APHIDS, SPIDER MITES, WHITEFLIES, THRIPS, SANDFLIES, JASSIDS, SCALE INSECTS.
EFFECTIVE 14 DAYS
IS SAFE AND EASY TO HANDLE

For full information on ROGOR 40 and details of FISONS ADVISORY SERVICE please contact

Agents:-

FISONS CHEMICALS (MALAYA) LTD.
P. O. BOX 865 SINGAPORE

Distributors:-

HARRISONS & CROSFIELD
all branches

FISONS PEST CONTROL LIMITED

GIVE YOU EFFECTIVE CONTROL
OF A WIDE RANGE OF INSECT
PESTS IN AGRICULTURE, ESTATE
HYGIENE, & PUBLIC HEALTH

DIAZINON

THE POWERFUL CONTACT INSECTICIDE

ESPECIALLY EFFECTIVE AGAINST
CATERPILLARS, BEETLES, COCKROACHES,
ANTS, MOSQUITOES, BEDBUGS,
SILVERFISH, FLIES, ETC.

For full information on DIAZINON
and details of FISONS ADVISORY
SERVICE please contact

Agents:-

FISONS CHEMICALS (MALAYA) LTD.
P. O. BOX 865 SINGAPORE

Distributors:-

HARRISONS & CROSFIELD
all branches

AVAILABLE PUBLICATIONS OF THE DEPARTMENT OF AGRICULTURE, FEDERATION OF MALAYA.

LEAFLETS (Issued free for circulation in the Federation of Malaya only)

AGRICULTURAL SERIES

No. 1. Derris. (1948). E.
4. Groundnuts. (1949). E
9. Pepper. (1956). C M E
25. Manila Hemp. (1947). E
26. The Black Beetle. (1947). E
28. Ramie. (1950). E
29. The Coconut Leaf Moth. (1951). E
30. Fermentation and Drying of Cacao Beans. (1956). E
31. Cacao. (1955). C M E
32. The Establishment and Maintenance of Fruit Trees. (1956). C M
33. Patchouli. (1957). C M E
34. Oil Palm. (1956). E
35. Home Canning and Jam Making. (1957). C M E
36. The Pineapple in Malaya. (1958). C
37. Coffee. (1958). C M E
38. Grow Your Own Nutritious Vegetables. (1958). M E
39. Soil Conservation and Erosion Control. (1958). C M E
40. Compost. C M E
41. Coconuts. (1959) C M E
42. Food from Soya Beans. (1959) M E.

POULTRY LEAFLETS

No. 1. Systems of Poultry Keeping. (1954). C M E
2. The Housing of Poultry. (1955). C E
3. The Feeding of Poultry. (1954). C M E
4. The Choice of Stock. (1955). C E
5. Duck Keeping. (1958). C M E

M = printed in Malay. C = printed in Chinese. E = printed in English.

RECENT BULLETINS

107. Mineral Deficiency Symptoms of Cacao grown in Sand-culture. (1959). $4.
108. Mineral Nutrition of the Rice Plant (1959). $6.
109. Rice Variety Trials 1954-58 (1959). $3.
110. Common Diseases and Pests of Malayan Crops (1959). $1.

SCIENTIFIC SERIES (Discontinued after No. 26)

No. 2. Investigations on Panama Disease in Malaya. (1930). $1.
3. An Historical Note on *Tirathaba rufivena* Walk. (The Greater Coconut Spike Moth) and its Three Parasites in Malaya, and Preliminary Observations on *Sogata* spp. Pests of Padi. (1930). 50 cents
4. Bionomics and Control of *Leptocorisa acuta* Thunb. (1930). $1.
9. Hydnocarpus Oils in Malaya. (1932). 50 cents.
10. An Examination of the Geology and Soils of an Area in the State of Perak, F.M.S. (1932). 50 cents.
11. Lac in Malaya (Part I). (1933). 50 cents.
15. Notes on Hymenopterous Parasites of Padi Pests in Malaya. (1934). 50 cts.
16. The Toxic Value of *Derris* spp. (1935). 50 cents.
17. The Termite, *Microtermes pallidus* Hav., in Relation to Tea in Malaya. (1936). 50 cents.
18. The Oriental Migratory Locust (*Locusta migratoria manilensis* Meyen) and the Bombay Locust (*Patanga succincta* L.) in Malaya. (1936). 50 cents.
19. Lac in Malaya (Part II). (1937). 50 cents.
20. Insects, Fungi and Bacteria Associated with Copra in Malaya. (1937). 50 cents.
21. Observations on Stem-Rot of the Oil Palm. (1937). 50 cents.
22. The Identification of Grubs from Rubber Estates. (1939). 50 cents.
23. Malayan Food Composition Table. (1949). $2.
24. Fodders and Feeding Stuffs in Malaya. (1951). $5.
25. Rice Variety Trials in Malaya, 1947-50. (1953). $5.
26. Rice Variety Trials in Malaya, 1950-54. (1955). $5.

GENERAL SERIES (Discontinued after No. 32)

No. 2. The Brazil Nut in Malaya. (1930). 50 cents.
9. The Cultivation and Manufacture of Tea in Ceylon and India. (1932). $1.
10. Insects of Coconuts in Malaya. (1932). $1.50.
23. The Coconut Industry of the Philippine Islands. (1936). 50 cents.
28. The Practical Aspects of Copra Deterioration. (1937). 50 cents.
29. The Cultivation of Lowland Tea at the Central Experiment Station, Serdang. (1937). 50 cents.
31. Malay Leaf and other Vegetables and their Analyses. (1940). 50 cents.
32. The Pineapple Industry of the Hawaiian Islands. (1949). $5.

ECONOMIC SERIES (Discontinued after No. 15).

MECHANISATION SERIES (Discontinued after No. 1).

No. 1. Investigations into the Mechanical Cultivation of Padi in Malaya. (1951). $2.

DEPARTMENT OF AGRICULTURE, FEDERATION OF MALAYA.

The Director of Agriculture invites those interested to visit the College of Agriculture, Serdang, Selangor, and the various Federal and State Stations throughout the Federation Malaya. Intending visitors to the College of Agriculture should communicate with the Principal; to the Federal Experiment Station, Serdang, Selangor, with the Agronomist-in-charge; and to other Federal and State Stations with the State Agricultural Officers. The following is a list of Agricultural Stations on which can be studied the more important lines of investigation and extension at present carried out by the Department.

Correspondence concerning the experiments at any of these Stations should, if it originates in Malaya, be addressed to the State Agricultural Officer, concerned; correspondence originating in any other country should be addressed to the Director of Agriculture, Federation of Malaya, Kuala Lumpur.

Wet Padi.

SELECTION WORK. Telok Chengai, Kedah; Titi Serong, Simpang Tiga and Talang, Perak; Pulau Gadong, Malacca; Kota Bharu and Jelawat, Kelantan; Kendong, Ulu Klawang and Ampang Tinggi, Negri Sembilan; Tangkak, Johore; Genting and Bukit Merah, Penang and Province Wellesley; and other State Stations.

AGRONOMIC INVESTIGATIONS. Several Padi Experiment and Test Stations.

PADI MECHANISATION SCHEME, Parit, Perak.

Dry Padi.

Melor, Kelantan, and Paya Besar, Pahang.

Rubber.

Budwood and clonal seedling nurseries. Most State Agricultural Stations. Replanting demonstration plots in all States.

Tea.

Federal Experiment Stations, Cameron Highlands and Serdang.

Oil Palm.

Federal Experiment Stations, Serdang, Selangor, and Jerangau, Trengganu.

Coconut.

Federal Experiment Station, Telok Bharu, Perak, and Coconut (Rehabilitation) Station, Sungei Sudah, Muar, Johore.

Cacao.

FEDERAL EXPERIMENT STATIONS. Serdang, Selangor, and Jerangau, Trengganu.

AMELONADO SEED GARDENS. Sik, Kedah; Batang Merbau, Kelantan; Ayer Itam, Penang; Layang Layang Kiri and Bukit Gantang, Perak; Temerloh, Kuala Lipis and Pekan, Pahang; Ampang Tinggi, Negri Sembilan; Sungei Udang, Malacca; Ayer Hitam, Tangkak, Johore; Sungei Tong, Trengganu.

Peat Soil.

Jalan Kebun, Selangor.

Manila Hemp.

Federal Experiment Station, Serdang, Selangor; Degong, Perak; and Sungei Ruan, Pahang.

Fruit Propagation.

Federal Experiment Station, Serdang, and all State Agricultural Stations.

Vegetables.

Federal Experiment Stations, Kuala Lumpur and Cameron Highlands.

Poultry.

Federal Experiment Station, Cameron Highlands and most State Agricultural Stations.

Livestock.

PIGS: Federal Experiment Stations, Serdang and Cameron Highlands; Sungei Buloh and Jenjarom, Selangor; Mah San, Negri Sembilan; Raja Hitam (Dindings), Perak; Pulau Gadong, Malacca; and Ayer Itam, Penang.

GOATS: Ayer Itam, Penang; Bukit Mertajam, Province Wellesley; Sungei Udang, Malacca; Cheras, Setapak, Sabak Bernam and Federal Experiment Station, Serdang, Selangor; Chembong, Negri Sembilan.

Pastures.

Federal Experiment Station, Serdang, Selangor.

PRINTED BY THE ECONOMY PRINTERS LTD., KUALA LUMPUR.